U.S. Route 4 Corridor Management Study

Lebanon – Enfield – Canaan

Report to the Commissioner of the New Hampshire Department of Transportation

February 2007

Upper Valley Lake Sunapee Regional
Planning Commission
30 Bank Street
Lebanon, NH 03766

In Cooperation With:
New Hampshire Department of
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1.0 Introduction and Overview

1.1 Scope of the Study

The study area is the U.S. Route 4 corridor from the Canaan/Orange town line west to Interstate 89 Exit 17 in Lebanon, a distance of approximately 12 miles (Commutershed Map - Appendix A). The term "corridor" refers to the highway itself along with other closely associated land uses and transportation facilities.

The scope of the study included highway infrastructure, intersection safety, access management, the bicycle and pedestrian access, transit services, land use patterns and limitations, and important natural resources. Current conditions were assessed and future conditions projected and analyzed.

1.2 Goals of the Study

The purpose of a corridor management study is to bring local, regional, and state officials together to examine existing and future conditions along the highway, and to identify ways to maximize capacity, improve safety, and ensures that the public benefit from investment in the highway infrastructure is maintained. A primary goal of the US Route 4 Corridor Management Study is to maximize the potential of the corridor to serve economic development in Enfield and Canaan without impeding the flow of commuter traffic on this major artery to the Lebanon-Hanover job center. The aim is to develop recommendations for short and long-term strategies to prevent or reduce future traffic problems as growth occurs in the area.

One focus of this study is to identify any structural improvements that are needed now or that are likely to be needed in the future, before growth along the corridor further limits options. The second is to identify access management techniques, which can be used by communities along the Route 4 corridor to reduce conflicts between local and through-traffic. The third is to identify strategies to reduce the growth in the numbers of single occupant vehicles, especially at peak hours, to maintain the level of service of the corridor as commutershed communities continue to grow.

1.3 Description of the Process

A multi-pronged approach was utilized to exchange information with local officials, corridor land and business owners, and the public at large. Mechanisms to facilitate the sharing of study information and receive input on issues and recommendations included an advisory committee, two sets of public meetings in each corridor community, a landowner survey, a business owner survey, and a project web page on the Upper Valley Lake Sunapee Regional Planning Commission website.

Advisory Committee

To provide guidance and technical assistance throughout the study, an Advisory Committee was formed consisting of UVLSRPC and New Hampshire Department of Transportation staff and community liaisons. Each of the three communities was invited to appoint two individuals with planning expertise or a working knowledge of the highway. In addition, each community's representatives to the UVLSRPC were invited to participate, along with the chair of the UVLSRPC Transportation Advisory Committee. Participants included:

UVLSRPC
Tara Bamford, Executive Director
Peter Dzewaltowski, Senior Planner
Victoria Boundy, Senior Planner
Nathan Miller, Planner
Denyce Gagne, Planning Assistant
Van Chesnut, Executive Director, Advance Transit and Chair, UVLSRPC Transportation Advisory Committee

NHDOT
Dennis Fowler, GIS Manager, NHDOT liaison to UVLSRPC
Alan Hanscom, NHDOT District Engineer
Bob Barry, Administrator, NHDOT Bureau of Municipal Highways

Lebanon
Mark Goodwin, Senior Planner/GIS Coordinator
Joan Monroe, Planning Board & UVLSRPC representative

Enfield
Jim Taylor, Community Development Director
Ken Daniels, Director of Public Works
David Saladino, Planning Board

Canaan
Dana Hadley, Town Administrator
Laurie Hildebrandt, UVLSRPC representative

Advisory Committee meetings were held at the UVLSRPC office as follows:

August 23, 2005

> Presented overview of project, discussed scope and schedule, presented update on mapping, traffic data, and public participation plan, and discussed web page questions.

September 27, 2005

> Reviewed maps and traffic data, discussed public participation plan, and reviewed draft survey.

November 22, 2005
Discussed traffic data, and issues to be addressed by the study.

January 24, 2006
Discussed traffic analysis, survey results, report outline, preliminary recommendations, and identified additional sources of information on issues identified through the public meetings.

March 28, 2006
Discussed results of highway safety audit and use of the corridor by wildlife.

September 26, 2006
Reviewed traffic volume and level of service projections and associated recommendations.

October 24, 2006
Reviewed draft report.

November 14, 2006
Reviewed draft report.

January 16, 2007
Recapped public meetings in Lebanon, Enfield, and Canaan. Reviewed proposed revisions to draft report.

The information and assistance provided by Advisory Committee participants provided a key foundation of this study.

Public Meetings

Three public meetings in October and November 2005 provided UVLSRPC with valuable information on current and potential challenges and issues associated with the US Route 4 Corridor. In Canaan, the Selectboard hosted a public meeting in Canaan on October 25, 2005. There were thirteen attendees. The next night, the Enfield Planning Board hosted a public meeting in their community. Thirteen individuals attended that session as well. In Lebanon, an open house format was used at the Lebanon Public Library. At each event, residents and local officials shared their thoughts on current traffic conditions, land use development, management of access points, and alternative transportation and pedestrian issues.

The following are examples of issues that were repeatedly cited at the three public meetings:

- Poor sight distances at the intersection of Routes 4 and 4A
- Traffic back-ups at the Enfield Village School and Mascoma Valley Regional High School
- Congestion at the I-89 Exit 17 Interchange

- Numerous housing developments and village revitalization efforts in Enfield and Canaan, and their potential for increasing traffic volumes and conflicts
- Crosswalks and sidewalks needed to make connections for pedestrians, e.g. from Mascoma Valley Regional High School to the two nearby general stores, and from Main Street in Enfield to Brookside Plaza

Comments from each of the meetings have been compiled and summarized in Appendix A at the end of this report.

Surveys

Owners of undeveloped land zoned for business in the corridor, owners of land not restricted by zoning and owners of existing corridor businesses were provided a written survey. The purpose of the surveys was to learn more about the development potential of the corridor, to understand business owners' views of corridor issues, and to provide them with information about the study and the webpage created for the exchange of information on issues.

Surveys were mailed to the addresses in the property tax records, and in the case of businesses where it appeared likely that the business owner was a different individual than the landowner listed, or where multiple businesses existed on one property, surveys were hand delivered. It was acknowledged that this could possibly result in some duplication, however, with such a small target audience; the goal was to maximize input rather than be statistically correct.

Fifty owners of undeveloped land not limited to residential uses by zoning were identified and mailed a survey. Only fourteen responses were received for a response rate of 28%. The small number made it difficult to make generalizations based on this survey.

Sixty-eight surveys were distributed to business owners. Twenty-five were hand-delivered to the business and the rest were mailed. Twenty-five completed surveys were received for a response rate of 37%.

Changes reported as needed by business owners include:

- Intersection improvements
- Improvements to highway shoulders
- Left turn lanes
- Transit enhancements
- More sidewalks
- Crosswalks and other pedestrian amenities
- Bicycle lanes/paths

Business owners favored increased commercial development, concentrated development (as opposed to strip development), more business support services,

and increased highway capacity. The complete results of both surveys are provided in Appendices B and C at the end of this report.

Website

A webpage was created within the UVLSRPC website and was updated several times throughout the course of the project. Information was provided on the status of the study and on opportunities to participate. For several months questions regarding use of the corridor and user concerns were posted on the webpage with a mechanism to automatically send comments by email. The web address was provided to survey recipients, attendees at the public meetings, on flyers posted for the public meetings, and in a press release. However, few comments were received through this venue.

2.0 Corridor Analysis

2.1 Role of the Corridor

U.S. Route 4 is a rural two-lane undivided highway running east-west from East Greenbush, New York to Portsmouth, New Hampshire. Its functional classification is a minor arterial, which means that the roadway has three primary functions in the statewide transportation system: 1) To serve trips of moderate length; 2) To provide access to geographic areas smaller than those served by the highway system; 3) To provide intracommunity continuity, but not penetrate identifiable neighborhoods.

Route 4 is an east-west corridor. At the regional level, this is especially important given the lack of efficient east-west travelways in the Upper Valley Lake Sunapee region. However, the roadway also plays an important role at the statewide level because the roadway serves as a parallel facility to Interstate 89. Route 4 carries significant volumes of heavy vehicle traffic, both for local deliveries and for freight transport to the Baker River Valley.

Over the past 25 years, the role of the U.S. Route 4 corridor has changed significantly. The Upper Valley Lake Sunapee region has experienced significant growth in employment and population during this period, with many new residents settling east of the Upper Valley employment center of Hartford-Hanover-Lebanon. This pattern has resulted in sharp growth in Route 4 corridor communities, especially in the towns of Enfield and Canaan, and has transformed Route 4 into a commuter corridor serving the Upper Valley employment center. The U.S. Route 4 Commutershed includes the towns of Enfield, Canaan, Grafton, Orange, and Dorchester (Commutershed Map - Appendix A).

In addition to its role as a commuter corridor, Route 4 provides its communities access to essential services including hospitals and schools. Route 4 provides efficient access to the Dartmouth Hitchcock Medical Center in Lebanon, and serves all of the schools within the Mascoma Valley Regional School District. Route 4 also serves as the primary access to retail services. Although most communities within the

corridor have neighborhood-level retail services, Route 4 provides access to Hartford, Hanover, and Lebanon for larger shopping trips and other business services. The U.S. Route 4 corridor plays another important role: connecting key tourist destinations throughout the region and the state. At the statewide level, the corridor serves tourists by connecting communities along the Connecticut River to the Capital and Seacoast regions of the state. Route 4 also serves as an important tourist link between Interstate 91 in Vermont and the Lakes and White Mountains regions of New Hampshire. Many tourists use Route 4 (via Route 118) to access Plymouth, Laconia, and the White Mountains during the summer, especially around the time of Laconia's "Bike Week" motorcycle rally each year. At the regional level, the Route 4 corridor serves a number of local tourist destinations and recreational outlets including Mascoma Lake, the Northern Rail Trail, and Ruggles Mine.

Apart from functioning as a multi-purpose and multi-modal travelway, the Route 4 corridor plays another role- perhaps its most important role. Route 4 serves as "Main Street" for many of its communities, including the towns of Enfield and Canaan. Indeed, the corridor forms the core of these communities, with the issues facing the future of the corridor having a direct impact on the quality of life for residents. The following three sections will provide background on many of the issues facing the Route 4 corridor by providing an analysis of existing conditions along the Route 4 corridor, including current roadway conditions as well as current land use and socioeconomic trends of Route 4 corridor communities.

2.2 Current Roadway Conditions

The UVLSRPC conducted an analysis of existing conditions along the U.S. Route 4 corridor study area. Its purpose is to understand the current conditions of the roadway, including traffic volumes and capacity, and to evaluate how well the existing infrastructure meets current and future needs. This kind of analysis is helpful in determining the improvements that are needed to accommodate future growth and development along the corridor.

2.2.1 Roadway Attributes

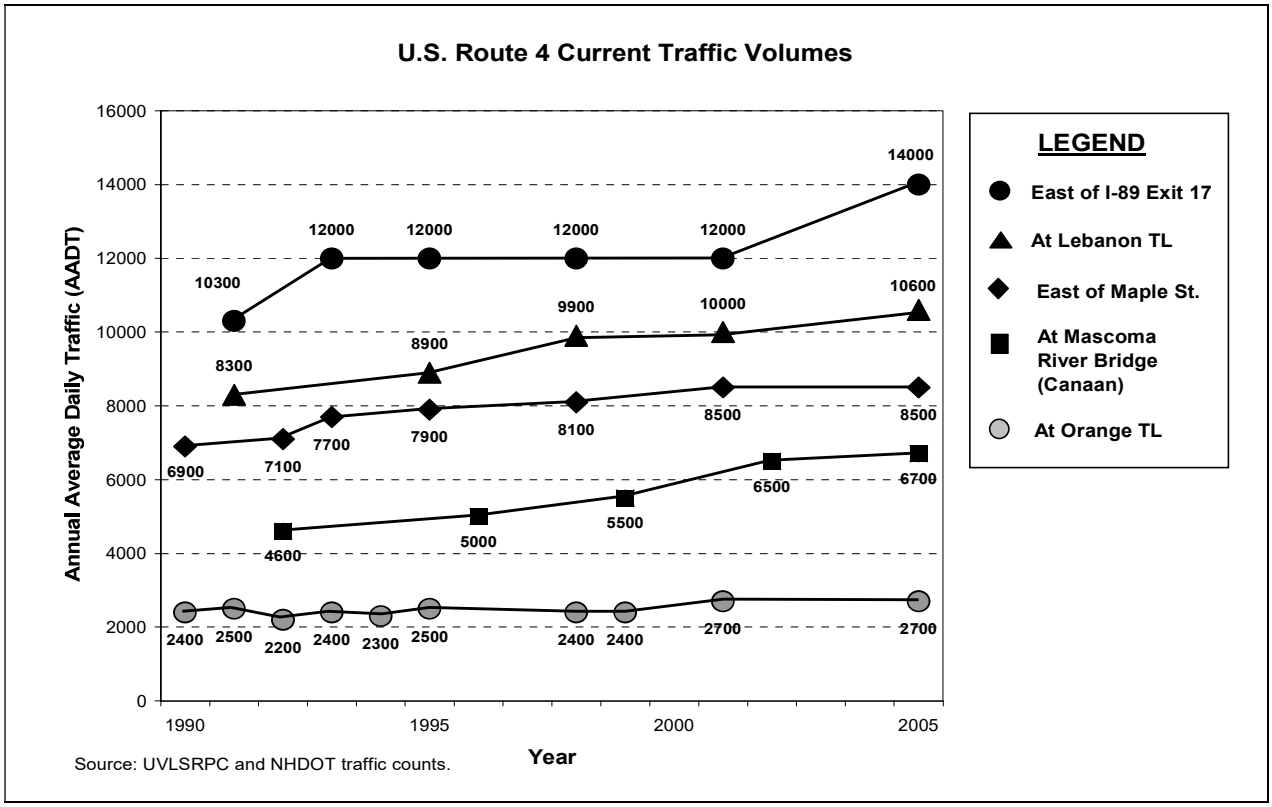
Travel lane and shoulder configuration vary throughout the corridor. Travel lanes vary from 10-12 feet, and shoulder widths vary from zero to 10 feet. The roadway is a paved surface, which is in good condition. Speed limits throughout the corridor vary from 30 MPH in village areas to 50 MPH in the straightest sections. There are currently no limited access sections within the 12-mile long study area. This means that there are access points along the corridor providing access and egress to residents and businesses along the roadway. There are currently no signalized intersections in the study area. U.S. Route 4 faces many constraints to future growth and development. A number of environmental features, including sharp topographic/elevation changes, constrain development along the corridor. The study area lies partially within the floodplains of the Mascoma and Indian rivers, and is periodically prone to flooding. Flooding along Route 4 is especially prevalent in the town of Canaan, in the area surrounding the Mascoma Valley Regional High School.

The study area is also home to a significant amount of protected/conserved land (Development Limitations Map - Appendix A). State right-of-way along the Route 4 corridor is by prescription (i.e., historic continued public use); as such, no comprehensive information about the width of state right-of-way is available.

2.2.2 Current Traffic Trends

Traffic counts were conducted at 12 locations throughout the study area. The counts were of various types including volume, speed, vehicle classification and turning movement counts (Traffic Count Locations Map - Appendix A). Traffic volumes throughout the corridor vary greatly. The general measure of traffic presented is an Annual Average Daily Traffic (AADT). The highest traffic volumes were observed near Interstate 89 at the western boundary of the study area, and the lowest at the Canaan/Orange town line. Figure 2.2.2 shows AADT for key locations throughout the study area.

FIGURE 2.2.2



Source: UVLSRPC and NHDOT traffic counts.

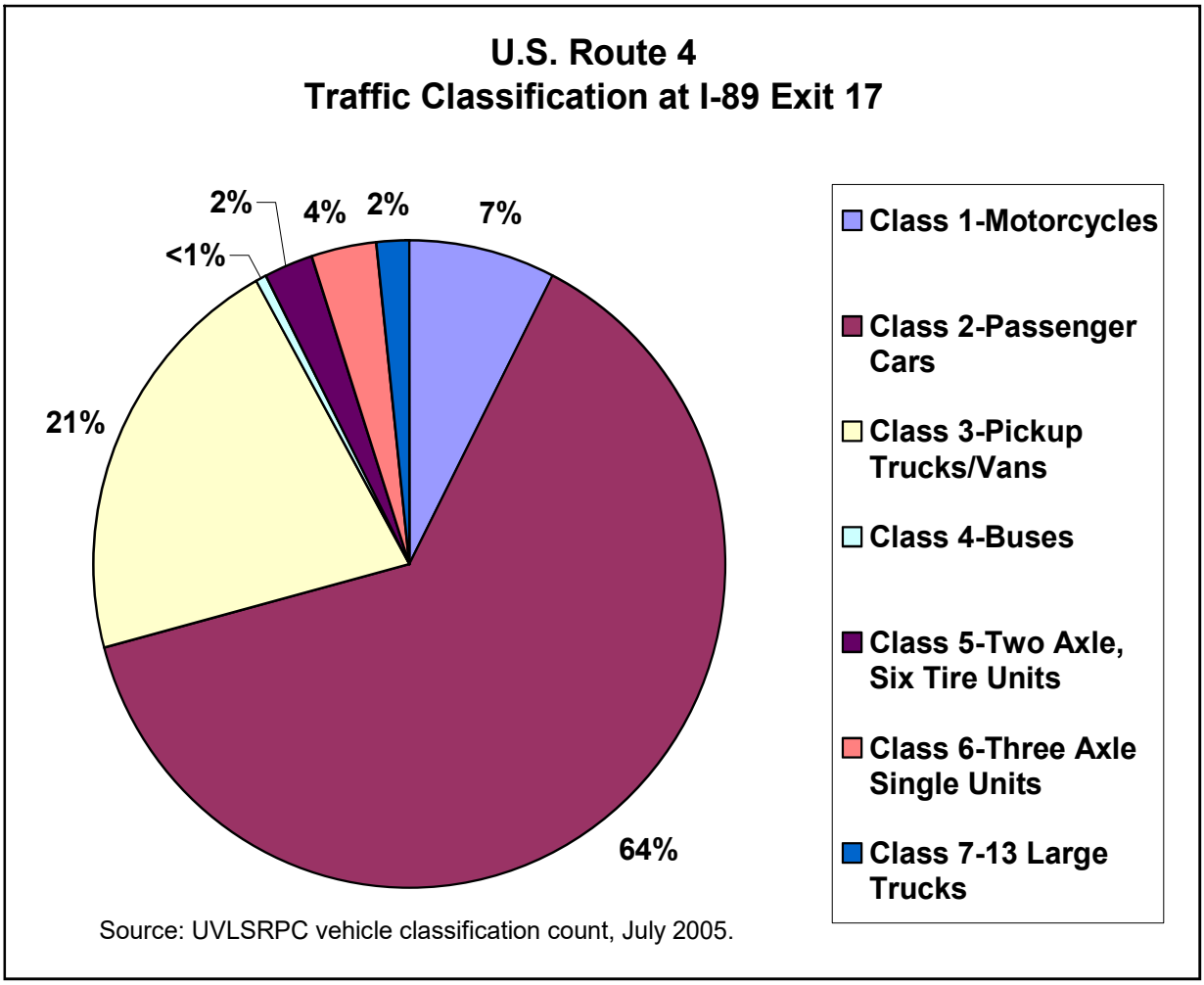
Over the past decade (1995-2005), traffic volumes have grown between 0.7 and 1.8 percent per year. Most growth has occurred from the Lebanon town line (1.8%) to Interstate 89 (1.7%). Locations furthest east have experienced the least growth and have the lowest traffic volumes.

Over a typical day the directional split in traffic is roughly 50/50. However, because of the commuting nature of the corridor, about 80 percent of traffic will be flowing either to or from the employment center during peak commuting hours.

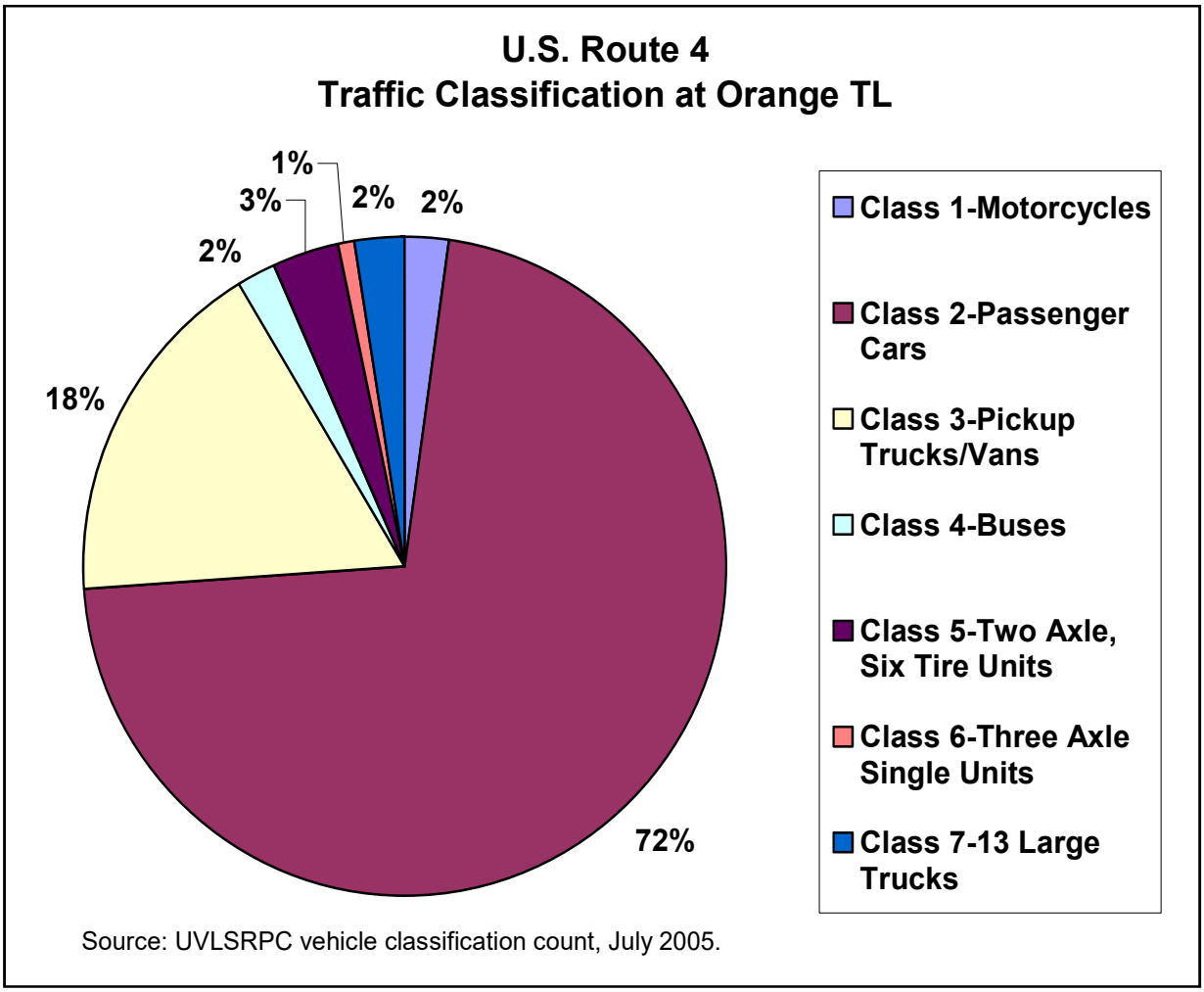
2.2.3 Traffic Composition

As Figure 2.2.3 shows, passenger vehicles, including passenger cars and pick-up trucks, are the predominant vehicle type using Route 4. However, the classification counts also show that the corridor sees significant heavy vehicle traffic.

FIGURE 2.2.3



Source: UVLSRPC vehicle classification count, July 2005.



Source: UVLSRPC vehicle classification count, July 2005.

At the I-89 exit 17 interchange, where traffic volumes are the highest in the study area, heavy vehicles comprise 8% of total traffic. At the eastern boundary of the study area, the Canaan/Orange town line, where traffic volumes are the lowest, heavy vehicles comprise 6% of total traffic. The data suggests that Route 4 is an important east-west freight corridor in the Upper Valley region.

2.2.4 Intersections

Turning movement counts were conducted and evaluated at five key intersections throughout the 12-mile long study area. Peak usage periods vary slightly, but occur generally from 7-8 AM and 4-5 PM. Table 2.2.4(A) presents a summary of morning and afternoon peak period turning movement counts.

TABLE 2.2.4(A)

U.S. Route 4 Turning Movement Count Summary					
Intersection	**City/Town**	**Peak Hours**		**Peak Hour Volume**	
		AM	PM	AM	PM
Route 4/Route 4A	Lebanon	7:15-815	4:45-5:45	1,327	1,528
Route 4/High St.	Enfield	7:00-8:00	4:45-5:45	970	1,094
Route 4/Maple/Main St.	Enfield	6:45-7:45	4:00-5:00	817	1,100
Route 4/Depot/Canaan St.	Canaan	7:15-8:15	4:45-5:45	642	601
Route 4/Route 118	Canaan	6:45-7:45	4:00-5:00	408	572

Source: UVLSRPC Counts, July 2005. Depot St. Intersection Count Nov. 2005.

Level-of-Service analyses were conducted for each intersection using the morning and afternoon peak period count data presented in Table 2.2.4(A). A Level-Of-Service (LOS) analysis is used according to the Highway Capacity Manual (HCM) to describe an intersection's operation (see Table 2.2.4(B)). Level-of-Service is a measure describing operational conditions within a traffic stream. Letters designate each level, from A-F, with LOS A representing the best conditions and LOS F the worst. Each LOS represents a range of operating conditions and the driver's perception of those conditions.

TABLE 2.2.4(B)

Level-Of-Service Criteria for Unsignalized Intersections		
LOS	**Prevailing Conditions**	**Average Control Delay Per Vehicle**
A	Little to no congestion	<=10 sec.
B	Slight congestion	>10 and <=15 sec.
C	Average congestion	>15 and <=25 sec.
D	Above average congestion	>25 and <=35 sec.
E	High levels of congestion	>35 and <=50 sec.
F	Extreme congestion	>50 sec.

Source: Highway Capacity Manual, HCM 2000, Transportation Research Board, 2000.

During the morning commute, there are two turning movements that are operating poorly. First, vehicles using Route 4A and turning left onto Route 4 are experiencing the worst level of service in the study area (LOS F). This situation is exacerbated by the fact that the Route 4/Route 4A intersection has the highest traffic volumes in the study area. The High Street and Route 4 intersection in the town of Enfield is also experiencing high levels of congestion (LOS E). Table 2.2.4(C) presents the detailed results of the Level-of Service analyses.

TABLE 2.2.4(C)

Intersection Approach* Level-of-Service** Summary				
Intersection	**AM Peak Period**			
	Northbound	Southbound***	Eastbound	Westbound***
Route 4/Route 4A	F	A	A	A
Route 4/High St.	E	N/A	A	A
Route 4/Maple/Main St.	C	B	A	A
Route 4/Depot/Canaan St.	B	B	A	A
Route 4/Route 118	N/A	A	A	N/A
Intersection	**PM Peak Period**			
	Northbound	Southbound	Eastbound	Westbound
Route 4/Route 4A	F	B	A	B
Route 4/High St.	C	N/A	A	A
Route 4/Maple/Main St.	C	D	A	A
Route 4/Depot/Canaan St.	B	B	A	A
Route 4/Route 118	N/A	B	A	N/A

** It is assumed that Route 4 runs east-west at all intersections.*
*** Level-of-Service projections developed using HCS2000 Version 4.1c*
**** During turning movement counts at the intersection of Route 4/Route 4A in the AM peak period, no vehicles were observed executing turning movements from the southbound or westbound approaches. By default, these approaches were deemed to be at LOS A.*

In the afternoon, there is again extreme congestion for Route 4A traffic, but High Street's LOS improves (LOS C). This is because, in the afternoon, there is no longer a large amount of traffic exiting High Street. The LOS analysis also suggests that congestion problems may be emerging at the Maple/Main Street intersection in Enfield. Currently, the Maple Street left turns are experiencing above average congestion in the afternoon peak period. All other approaches within the intersections examined are operating at average or above-average levels of service.

2.2.5 Route 4 Highway Segments

Highway segments of Route 4 were analyzed to see how well the two-lane highway operates based on terrain, geometric design, and traffic conditions. Capacity for a two-lane highway is 1,700 passenger cars per hour (pc/h) for each direction, and 3,200 for both directions combined. Modifications to highway grade, alignment, and cross-section can improve the operational efficiency of a two-lane facility. For instance, leveling steep grades makes it easier for large trucks to maintain speed, and thus, improves levels of service for the passenger cars that follow. The addition of passing lanes would also reduce the amount of time drivers spend following slower vehicles.

Sufficient shoulder width is also important for three reasons. First, shoulders allow for the maximum use of existing roadway capacity by providing drivers an opportunity to maneuver around left turning vehicles. Secondly, shoulders play important safety

roles by providing safe places for disabled vehicles to pull out of the flow of traffic and also by providing areas for emergency vehicles to bypass congestion. Thirdly, shoulders provide an area for bicyclists to travel the roadway.

The segment of Route 4 between the Lebanon town line and Ruddsboro Road (Study Area Map - Appendix A) is LOS E. There is sufficient highway capacity at this location; however, about 80 percent of the time when a vehicle travels this segment of roadway during the AM peak hour, it will be following another vehicle with no opportunity to pass. This situation is prevalent throughout the corridor.

2.2.6 Vehicle Speeds

A vehicle's compliance with speed limits may or may not be a factor in highway safety-it depends on whether or not the speed limits are set appropriately. Speed limits should be set based on the specific geometry and traffic characteristics of a roadway, and not determined simply by the 85th percentile speed. The "85th percentile" speed is a standard measure commonly used to set speed limits. If the speeds of all motorists are ranked from the slowest to the fastest, the "85th percentile" speed separates the slower 85 percent and the fastest 15 percent.

Using automatic traffic data recorders, vehicle speed studies were completed at two locations within the study area to determine how fast vehicles travel and whether current speed limits are set suitably (see Table 2.2.6). Results of the speed studies indicate that vehicles are traveling faster than the posted speed limit near the Interstate 89 exit 17 interchange, where the road is wide and relatively straight. Drivers tend to travel slower near the Mascoma River Bridge in Canaan, where traffic is entering and exiting a curve in Route 4. Overall, speed limits in the study area seem to be appropriate, and no significant issues related to speed limits were identified.

TABLE 2.2.6

U.S. Route 4 Vehicle Speeds				
Statistics	**East of I-89 Exit 17 Interchange (Lebanon)**		**At the Mascoma River Bridge (Canaan)**	
	Eastbound	**Westbound**	**Eastbound**	**Westbound**
85th Percentile Speed (MPH)	**46**	**49**	**48**	**46**
Number of Vehicles >55 MPH	198	616	161	2200
Percent of Vehicles >55 MPH	0.3	0.9	0.7	8.5
Mean Speed (MPH)	41	44	32	45
Posted Speed Limit (MPH)	**40**	**40**	**50**	**50**

Source: UVLSRPC Vehicle Speed Study, July 2005.

2.2.7 Alternative Transportation Options

Transit

Advance Transit operates bus service (Blue Route) along Route 4 between the towns of Canaan and Hanover with stops in downtown Lebanon, Centerra Business Park, and other locations. Two buses serve the route throughout the day, and a third bus operates during peak periods. The Blue Route accounts for approximately 41 percent of Advance Transit's regular fixed route ridership. It carries more than twice the riders as the Red Route (Lebanon to Hartford), and more than the Orange (West Lebanon Plaza Shuttle), and Green (West Lebanon to Norwich) Routes combined. Blue Route ridership increased 16 percent from over 100,000 boardings in 2002 to close to 116,000 in 2004. On a daily basis, the directional distribution of ridership has been nearly equal. However, during the morning peak, the dominant direction of travel is westbound toward the Lebanon-Hanover employment center, and in the afternoon eastbound towards Enfield and Canaan. This route is also popular with Mascoma Regional High School students in the "reverse peak" direction, towards Lebanon in the afternoon. Presumably these students are traveling to after-school jobs or other extra-curricular activities.

An Advance Transit bus picks up passengers on U.S. Route 4 in Enfield.

Pedestrian and Bicycle

Existing pedestrian facilities are limited to the village areas of Enfield and Canaan. Even within these settlements, sidewalks do not connect many of the major points of origin and destination. Sidewalk extensions can improve safety and encourage walking and transit use. Currently, sidewalks do not exist in the following key areas:

- Connecting Enfield's Main Street and new commercial development to the east, terminating at the Enfield House of Pizza
- Connecting Canaan Village to Canaan School Street
- Along the east side of Main Street in Enfield between the Police Station and US 4 (in front of Mascoma Bank & Huse Park)

The old Boston and Maine Northern Rail line parallels U.S. Route 4, and has not operated in many years. Currently, no track exists between Lebanon and Canaan, and the rail trail is primarily for recreational use. There are four formal public access points to the rail trail in the study area (Study Area Map - Appendix A). In the city of Lebanon, an access point exists along Route 4 adjacent to Icehouse Road. In the town of Enfield, there is a formal access point on Main Street at the Mascoma Lakefront. In the town of Canaan, there are two access points to the rail trail, one

along Route 4 adjacent to Black Water Road, and a second at the end of Depot Street in Canaan Village. The development of additional public access points along the rail trail would encourage additional use by pedestrians and cyclists.

2.2.8 Parallel Facilities and Alternate Routes

Route 4A
The 4th New Hampshire Turnpike, now known as NH Route 4A, is another significant travelway to the south of Route 4 (Study Area Map - Appendix A). Moving west toward the interstate, traffic increases significantly on Route 4A. Also, Route 4A provides access to many of the homes with frontage on Mascoma Lake. In terms of traffic volumes, Route 4A is the most significant roadway that intersects with Route 4 within the study area.

Sunset Rock Road
The Sunset Rock Road begins at Route 4 in Lebanon (east of the Route 4 and 4A intersection) and travels north, ending at the intersection of Jenkins Road and Stevens Road (Study Area Map - Appendix A). The Sunset Rock Road has been identified in public meetings as a bypass around the congestion of the Route 4/4A intersection, with drivers using the Stevens Road and Hardy Hill Road to reconnect to Route 4 closer to downtown Lebanon. Drivers may also use the Sunset Rock Road (via Jenkins Road) as a through-route to access the Greensboro and Hanover Center Roads in the town of Hanover. Although no traffic count data is currently available, anecdotal evidence suggests that the use of the Sunset Rock Road is increasing.

Ruddsboro Road
Starting at Route 4 in Lebanon, Ruddsboro Road travels north to the towns of Hanover and Lyme (Study Area Map - Appendix A). Ruddsboro Road was also identified in public meetings as a shortcut to the Lebanon-Hanover employment center. Recent traffic volume data supports the anecdotal evidence that Ruddsboro Road is increasingly being used as an alternative to Route 4. In 2003, Ruddsboro Road saw an average annual daily traffic volume of 690 vehicles per day. However, in 2006, the average annual daily traffic volume grew to approximately 980 vehicles per day. Although this limited data does not yet constitute a long-term growth “trend” along Ruddsboro Road, it does indicate that the road has recently seen a significant increase in use.

Goose Pond Road
Starting at Route 4 in Canaan, Goose Pond Road travels north to the town of Hanover (Study Area Map - Appendix A). It is a possible alternative route to Etna Road in Lebanon, and to the northern area of Hanover near major employers. Currently, Goose Pond Road sees an average annual daily traffic volume (AADT) of 1,080 vehicles per day near its intersection with Route 4. Public input indicated that commuters were increasingly using the road as a shortcut to Hanover. Unfortunately, no trend information is currently available to determine if its use is increasing.

2.2.9 Route 4 Road Safety Audit

As part of the analysis of existing conditions along the Route 4 corridor, UVLSRPC staff, members of the project advisory committee, and New Hampshire Department of Transportation staff conducted a road safety audit of the Route 4 corridor. Participants included:

UVLSRPC
Peter Dzewaltowski, Senior Planner

NHDOT
Dennis Fowler, GIS Manager, NHDOT liaison to UVLSRPC
Alan Hanscom, District Engineer
Bob Barry, Administrator, Bureau of Municipal Highways
Bill Oldenburg, Chief of Preliminary Design
Bill Lambert, Bureau of Traffic

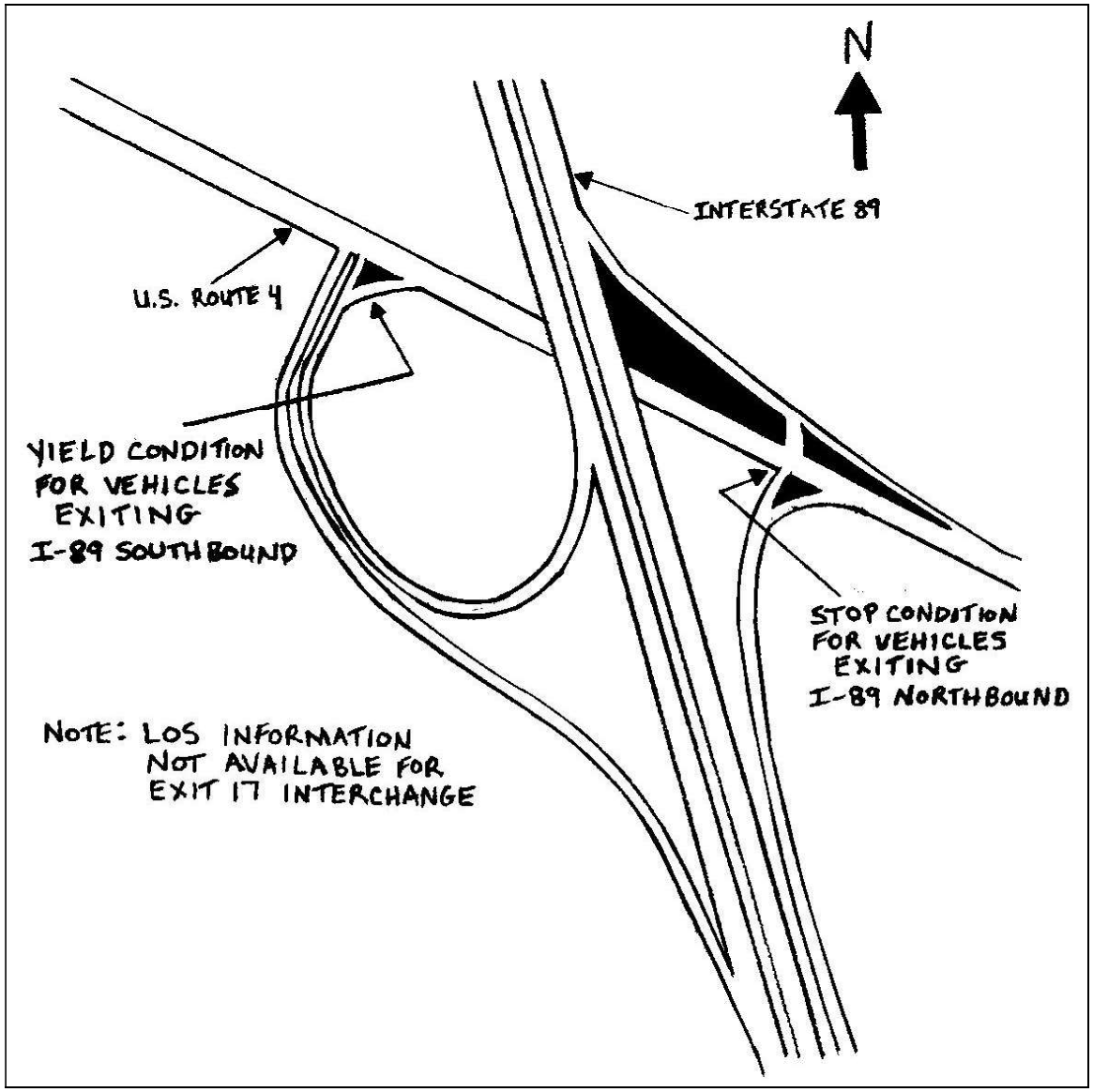
The purpose of the audit was to identify specific issues related to safety and infrastructure within the study area. Although the most common method of identifying a hazardous highway location is by the number of crash occurrences, this approach is reactive and depends upon crash history. The crash reports maintained by the New Hampshire Department of Transportation indicate that there are no high accident locations within the 12-mile long study area. However, there remain areas for concern. The following summarizes the results of the Route 4 road safety audit, with issues organized under three categories: intersection-related concerns, sight distance concerns, and infrastructure concerns.

Intersection-Related Concerns

The combination of poor intersection design and congestion can result in accident increases. Intersections should be designed to maximize the use of their existing capacity, which in turn will reduce congestion and the likelihood of accidents. The audit team identified several intersections in the study area that exhibited poor intersection design, resulting in increased congestion and inefficiency.

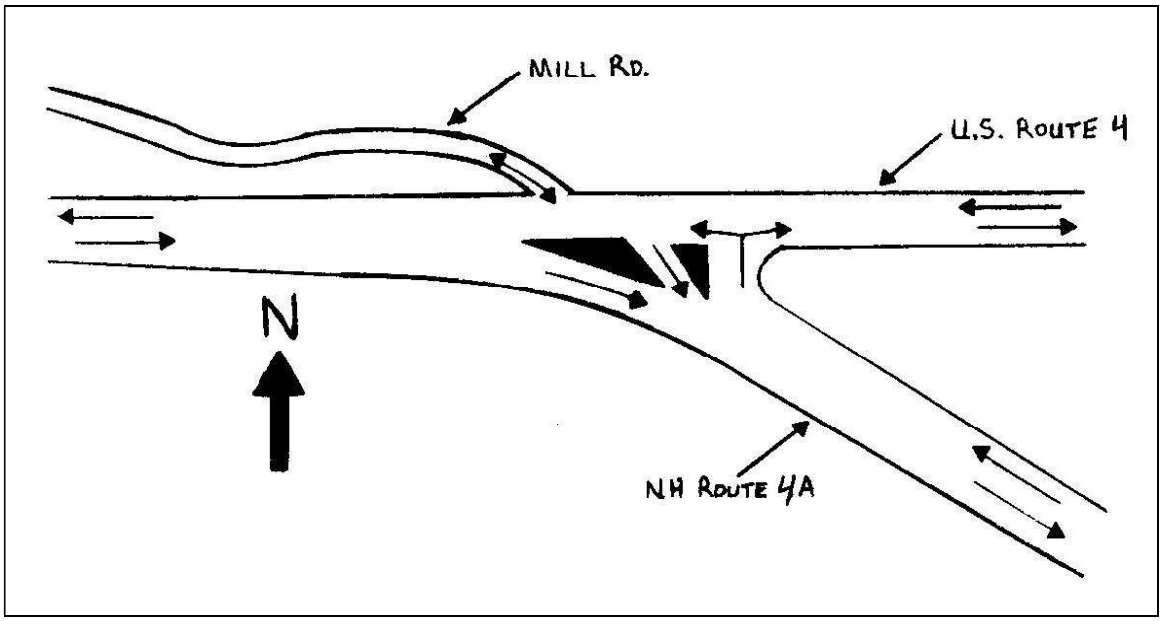
1) The design of the ***I-89 Exit 17 interchange*** makes it difficult for vehicles exiting from I-89 northbound to enter the traffic stream. This is the result of a yield condition for southbound exiting traffic, and is exacerbated both by the increasing traffic volumes at the interchange and by sight distance issues related to seeing eastbound Route 4 traffic. There are also times when it is difficult for vehicles exiting I-89 southbound to find gaps in Route 4 traffic, which occasionally causes back-ups onto the interstate. See Figure 2.2.9 (A).

FIGURE 2.2.9 (A)- DIAGRAM OF I-89 EXIT 17 INTERCHANGE



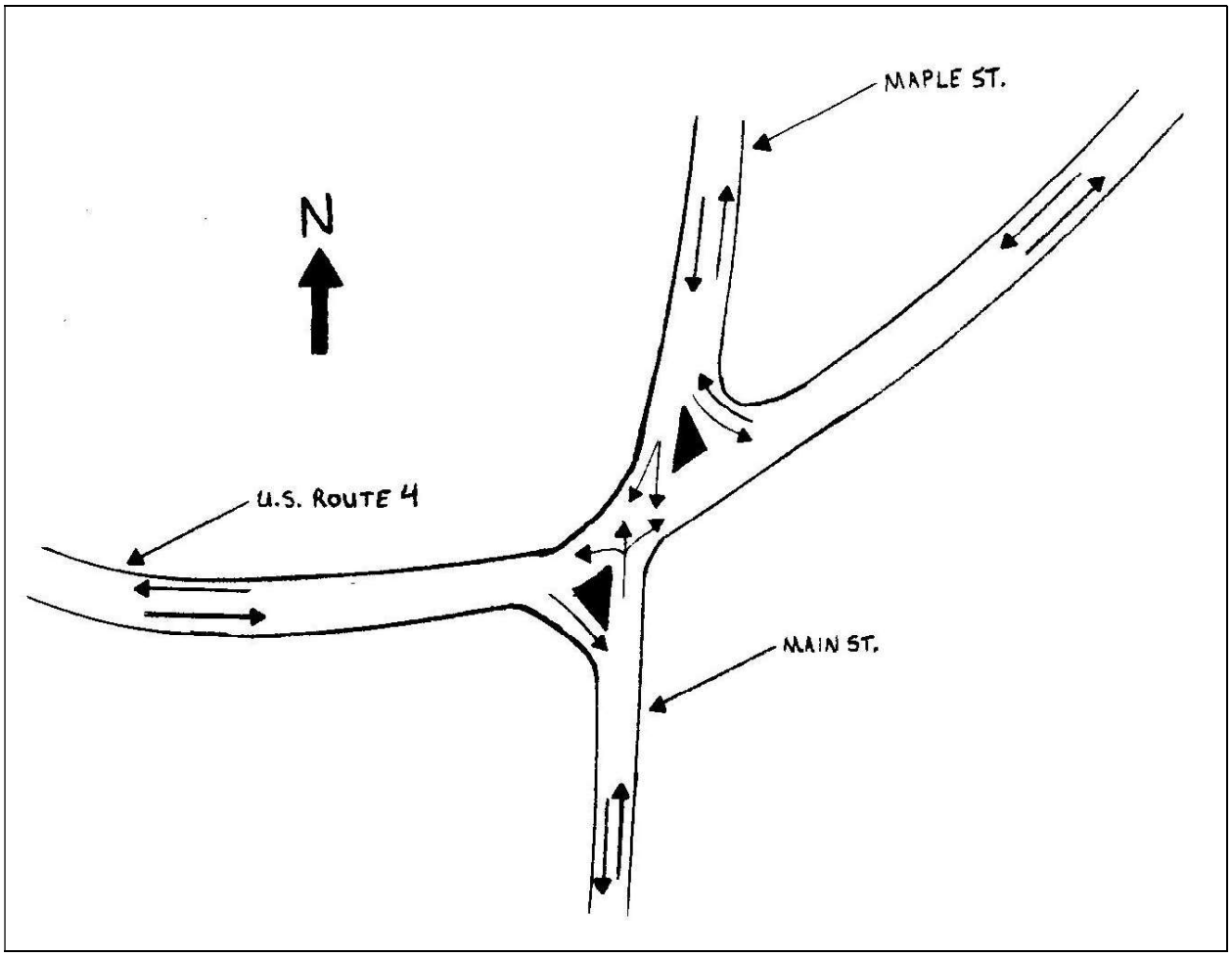
2) With the existing congestion at the ***U.S. Route 4/NH Route 4A intersection***, drivers entering Route 4 are rushing to enter the traffic stream in smaller gaps. With vehicles entering the traffic stream at shorter intervals, the likelihood of accidents occurring at the intersection increases dramatically. This behavior was observed during the road safety audit, and could become a significant safety issue as congestion increases at the intersection. Also, traffic turning from Route 4A onto Route 4 has difficultly seeing westbound traffic on Route 4 due to the bridge railing. This condition exacerbates the existing safety issues related to traffic merging into Route 4 with small gaps. See Figure 2.2.9 (B).

FIGURE 2.2.9 (B)- DIAGRAM OF U.S. ROUTE 4/NH ROUTE 4A INTERSECTION



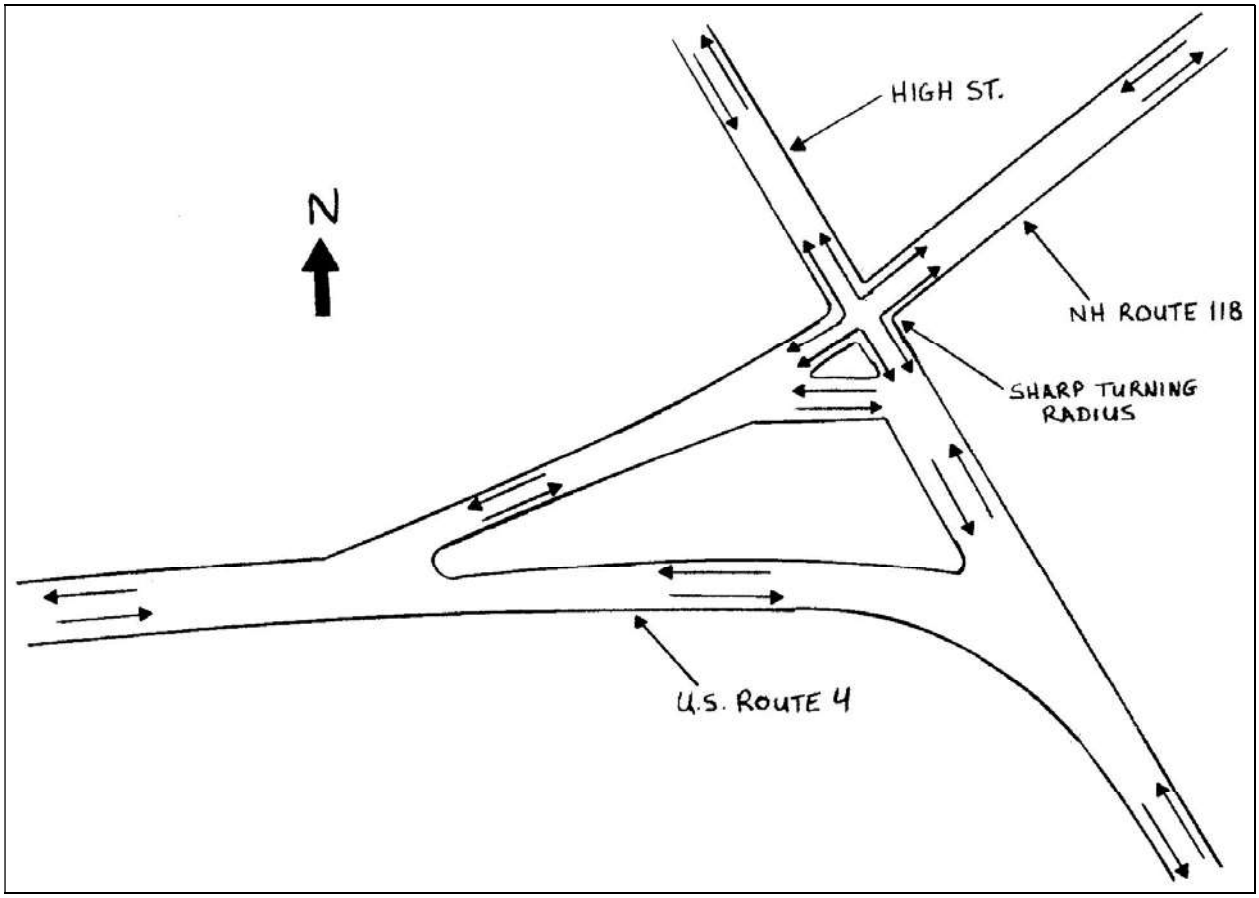
3) The congestion at the intersection of ***U.S. Route 4/Maple/Main Street*** in Enfield is partially the result of poor intersection design. Specifically, there are safety concerns related to the two grass islands in the intersection. The islands create more potential vehicle-vehicle conflict points for drivers to navigate through, and present difficult skew angles (the angles of roadway intersection) for drivers turning onto Route 4 from Maple and Main Street, and for traffic moving from Main Street to Maple Street across Route 4. Huse Park can be accessed both by Route 4 and by Main Street. However, the Route 4 access to Huse Park immediately east of Main Street is located too close to the intersection. This has resulted in additional vehicle-vehicle, vehicle-pedestrian, and vehicle-bicycle conflicts. The Route 4/Maple/Main Street intersection has been identified as potentially unsafe for pedestrians, especially those crossing Route 4 from Main Street to Maple Street. See Figure 2.2.9 (C).

FIGURE 2.2.9 (C)- DIAGRAM OF U.S. ROUTE 4/MAPLE/MAIN ST. INTERSECTION



4) The design of the ***U.S. Route 4/NH Route 118 intersection*** in Canaan makes it difficult for heavy vehicles to execute turning movements. This is the result of poor intersection geometry, namely the sharp turning radius for westbound Route 4 traffic turning right from High Street onto Route 118. As a result, it is virtually impossible for large vehicles to turn from Route 4 westbound onto Route 118. See Figure 2.2.9 (D).

FIGURE 2.2.9 (D)- DIAGRAM OF U.S. ROUTE 4/NH ROUTE 118 INTERSECTION



Sight Distance Concerns

Roadway intersections increase the likelihood of accidents, especially if visibility is inadequate. Sight distances should be of sufficient length that drivers may control their vehicles when passing, stopping, or entering a traffic stream at an intersection. There are several locations within the study area that the audit team identified as having insufficient sight distances (Road Safety Audit Results Map - Appendix A).

1) The topography in the vicinity of Shaker Valley Auto in Enfield limits the line of sight for vehicles traveling in both directions on Route 4. A heavily used entrance to Shaker Valley Auto is located just east of the vertical curve, and traffic entering and exiting is not adequately visible to traffic on Route 4.

2) There are significant sight distance concerns related to driveways in the section of Route 4 between Daniels Mobile Home Park in Enfield and the Enfield/Canaan town line. The sight distance concerns in this area result from sharp grade changes, and are exacerbated by the curvilinear nature of the roadway. Specifically, the audit team identified sight distance concerns in the vicinities of Baltic Street and Anderson Hill Road in Enfield.

Infrastructure Concerns

Roadway infrastructure should be developed to facilitate the multi-purpose and multi-modal use of the corridor. Infrastructure insufficiencies not only result in the inefficient use of a roadway's capacity, but can also create significant safety concerns. The audit team identified a number of locations in the study area (Road Safety Audit Results Map - Appendix A) where important infrastructure was lacking or deteriorated, resulting in inefficient or unsafe use of the roadway.

1) The lack of appropriate shoulders is an issue throughout the study area. Shoulder widths vary throughout the corridor, and much of the roadway has no shoulder. Roadway shoulders have three important purposes. First, they allow drivers to navigate around left-turning vehicles on two lane facilities, which allows for the unimpeded flow of traffic. Second, they serve important safety roles by providing safe places for disabled vehicles to pull out of the flow of traffic and for emergency vehicles to bypass congestion. Third, shoulders provide a safe area for bicyclists to travel the roadway. For arterial roads like Route 4, shoulder width should be 4 feet at a minimum.

2) The truck-climbing lane east of the I-89 Exit 17 interchange ends abruptly prior to the top of a steep hill. However, extending this lane would be very difficult due to the limited right-of-way available. Although this issue remains a concern, truck-climbing lanes are becoming less applicable because of the increased power of modern truck engines.

3) Flooding is a serious concern, primarily in the vicinity of the Wayside Chapel west of the Canaan "S-curves". Historically, this area of the roadway has been prone to flooding, with the most recent floods occurring in May 2006. To mitigate these flooding issues, the roadway may have to be raised in this area.

4) Mill Road, from just west of the Route 4/4A intersection to the Eastman Hill Road, is prone to erosion problems and landslides. If the erosion issues continue in the current pattern, Route 4 will be threatened.

5) Sidewalks are needed in a number of key areas throughout the study area. Specifically, the road audit team identified the need for sidewalks between Canaan Village and Canaan School Street, between Main Street and Brookside Plaza, between Cambridgeville and Prospect Pines, and between schools and villages/convenience stores.

6) A number of retaining walls in the study area are in need of repair. For example, the retaining wall along Route 4 east of Enfield village will need to be repaired or replaced. Periodic maintenance will need to occur to prevent other retaining walls from falling into states of disrepair.

7) The study area lacks an official park-and-ride location although transit use along the Route 4 corridor is the highest in the region. One potential location

for an official NHDOT park-and-ride location could be the existing Mascoma Valley Regional High School campus in Canaan (if the school moves to a proposed location adjacent to the Enfield/Canaan Town Line).

8) There are very few formal accesses to the Northern Rail Trail within the study area. Given that the Rail Trail runs parallel to Route 4, more accesses and parking areas should be provided to facilitate increased pedestrian and recreational travel.

2.3 Current Land Use

Land use along the Route 4 corridor varies significantly in each of the study area communities. Beginning in the City of Lebanon, in the vicinity of the I-89 exit 17 interchange at the western extent of the study area, there is an area of highway-oriented commercial development to the south of Route 4. Most prominently, the Northern States Tire retail store and warehouse is located in this area. Moving east, steep grades between the I-89 Exit 17 interchange and the intersection of Route 4/Route 4A have posed development challenges. As a result, this area has seen only sparse residential development and remains largely undeveloped. Between the intersection of Route 4/Route 4A and the Lebanon/Enfield town line, there has been more intense residential development. This is especially apparent in the vicinity of the Payne and Ruddsboro Roads as well as around the Mascoma Lakefront. There are some neighborhood-level retail and religious establishments in this section of the study area as well, most notably, the Church of Jesus Christ and the Latter Day Saints.

In the Town of Enfield, residential development intensifies moving east from the Lebanon/Enfield town line to Oak Grove Street. The Enfield village center, which is centered around the intersection of Route 4/Maple/Main Street, is characterized by a mix of stand-alone businesses, essential service establishments, recreational areas, and residential developments. Key establishments in this area include the Enfield Village School, Huse Park, Enfield Pro Hardware, and Moose Mountain Realty. Moving east from the Enfield village center, there has been a recent emphasis on encouraging new commercial and residential development. This trend has resulted in new strip-style commercial development, most notably Brookside Plaza and the plaza housing the Enfield House of Pizza and Dunkin Donuts.

In the Town of Canaan, the lack of zoning has resulted in a wide variety of uses along the Route 4 corridor. Moving east from the Enfield/Canaan town line, there are pockets of concentrated residential development surrounding the Mascoma Valley Regional High School. However, between the high school and the Canaan village, the corridor lies within the Mascoma and Indian River floodplains and remains largely undeveloped, with only sparse residential development. Also, some large-scale commercial/industrial developments have arisen in this area, notably Chapin Park. The Canaan village center, which is centered around the intersection of Route 4/Depot/Canaan Street, features a mix of public buildings, residential development, and neighborhood-level retail. The Canaan Town Library, Methodist Church, and

Evans Expressmart are all located in this vicinity. At the eastern extent of the study area, between the Canaan village center and the Canaan/Orange town line, the corridor remains mostly undeveloped; however, small pockets of residential development exist in this area, most notably between Highland Avenue and Ballpark Road.

City of Lebanon

In the City of Lebanon, the existing zoning ordinance is in the process of being revised. This is discussed further in Section 3.2. Currently, four zoning districts abut Route 4 within the study area (Existing Zoning Map - Appendix A): General Commercial (GC), Rural Lands One (RL-1), Rural Lands Two (RL-2), Rural Lands Three (RL-3). Specific characteristics of each zoning district are detailed in Table 2.3.

General Commercial

A General Commercial district is located at the western extent of the study area in Lebanon, near the I-89 Exit 17 interchange. As shown, the General Commercial district is located on the south side of Route 4, east of the Stoney Brook Road. The purpose of the General Commercial district is to "provide ample land with good highway access for the location of commercial development serving the local and regional markets" (*City of Lebanon, Zoning Ordinance, 2003.*) Permitted General Commercial uses include retail stores, service businesses, banks, and restaurants.

Rural Lands One

There are two districts within the study area that are designated as Rural Lands One. The first is located immediately east of the I-89 Exit 17 interchange on the north side of Route 4, ending at the intersection of Route 4/Riverside Drive. The second is located between the intersection of Route 4/Route 4A and the Lebanon/Enfield town line. According to the City of Lebanon's Zoning Ordinance, the purpose of the Rural Lands One district is "to provide areas of transition between the denser urban neighborhoods of the R Districts and the more sparsely settled and/or more environmentally sensitive RL-2 and RL-3 areas." Permitted Rural Lands One uses include single family homes, clustered housing developments, and home-based businesses.

Rural Lands Two

A Rural Lands Two district encompasses both sides of Route 4 beginning at the intersection of Route 4/Riverside Drive and ending approximately 1000 feet west of the intersection of Route 4/Route 4A. The purpose of the Rural Lands Two district is to "provide land for low density, rural living" (*City of Lebanon, Zoning Ordinance, 2003*). Permitted Rural Lands Two uses include single agriculture, single family homes, and home-based businesses.

Rural Lands Three

A Rural Lands Three district abuts the north side of Route 4, beginning at the intersection of Route 4/Route 4A and ending approximately 1000 feet west. There are two purposes of the Rural Lands Three district. One is to provide lands "for forestry and only limited development for single family homes on large lots". The second is to provide lands that are "reserved for future expansion when the necessary utilities and road systems are designed or in place" (*City of Lebanon, Zoning Ordinance, 2003*). Permitted Rural Lands Three uses are agriculture and single family homes.

Town of Enfield

In the Town of Enfield, two zoning districts currently abut Route 4 within the study area: Community Business (CB) and Rural Residential One (R1). Specific characteristics of each zoning district are detailed in Table 2.3.

Rural Residential One

The Rural Residential One district surrounds Route 4 in the eastern portion of Enfield beginning at the Lebanon/Enfield town line and ending just east of Morhouse Lane. The purpose of the Rural Residential One district is to provide land for residential development, religious institutions, and agriculture (*Town of Enfield, Zoning Ordinance, 2006*). Permitted uses include single and multi-family residential development, home-based businesses, and non-livestock farming.

Community Business District

The Community Business district is intended to extend Enfield's village center, and encompasses both sides of Route 4 beginning just east of Morhouse Lane and ending at the Enfield/Canaan town line. The primary purpose of the Community Business District is to provide land for a mixture of residential, commercial, and institutional development. Permitted uses include retail stores, business offices, and essential service centers. Single and multi-family homes and home-based businesses are also permitted.

Town of Canaan

The Town of Canaan does not currently have a zoning ordinance in place. Without a zoning ordinance, the town has had little regulatory control over development. However, the town is currently developing a draft zoning ordinance. The provisions of Canaan's draft zoning ordinance will be discussed in Section 3.2.

TABLE 2.3

Selected Zoning Characteristics of U.S. Route 4 Corridor Communities					
Town	**Zone**	**Front Setback**	**Frontage**	**Minimum Lot Size (Acres)**	**Notes**
City of Lebanon	Rural Lands One (RL-1)	40’	150’	1.0 (Class 1 or 2) 3.0 (Class 3)	Maximum 15% building coverage
	Rural Lands Two (RL-2)	40’	150’ (Class 1 or 2) 200’ (Class 3)	1.0 (Class 1 or 2) 3.0 (Class 3)	Maximum 20% building coverage (10% for Class 3)
	Rural Lands Three (RL-3)	50’	N/A	10	Maximum 1% building coverage
	General Commercial (GC)	40’	N/A	1.15	Maximum 30% building coverage
Town of Enfield	Residential 1 (R1)	20’	75’	1.0	.5 Acres for dwellings using municipal water and sewer
	Community Business District (CB)	30’	N/A	1.0	.5 Acres for commercial buildings using municipal water and sewer
Town of Canaan	***No Zoning Ordinance Currently in Place***				

2.4 Current Socioeconomic Conditions

To develop a clearer picture of the Route 4 corridor and the individual communities within it, an analysis of key socioeconomic variables was undertaken. Specifically, variables including population, housing, and employment were analyzed to determine current growth trends and project future growth along the Route 4 corridor.

U.S. Census historical population statistics and New Hampshire Office of Energy and Planning population projections were compiled as part of this study. Figure 2.4(A) presents a 40-year trend (1960-2000) of population growth, with 20-year (2000-2020) future population projections for Route 4 study area communities.

FIGURE 2.4(A)

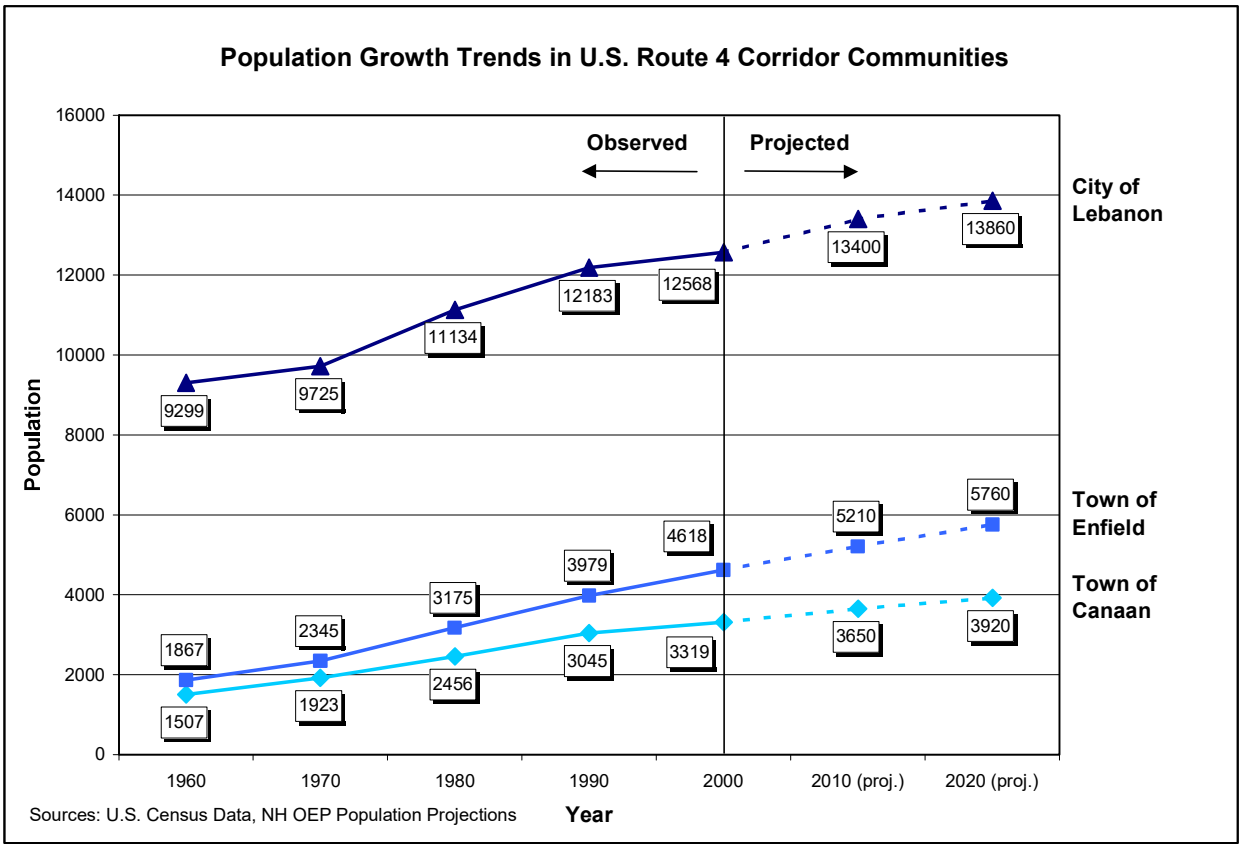


Figure 2.4(A) shows that, between 1980 and 2000, the City of Lebanon experienced very modest growth, while the towns of Enfield and Canaan each experienced sizeable growth. The Town of Enfield grew at an average rate of 2.3% per year between 1980 and 2000, a rate nearly four times larger that of Lebanon, which grew at an average rate of 0.6% per year during the same period. Similarly, the Town of Canaan saw an average growth of 1.8% per year, nearly three times the rate of Lebanon. It is important to note that between 1980 and 2000, the City of Lebanon added more population than the towns of Enfield and Canaan. However, the growth rates of Enfield and Canaan, when compared to Lebanon, tell an important story about the growth patterns along the corridor. There are a number of reasons for this population shift. The primary reason is the availability of housing in the towns of Enfield and Canaan to serve the employment growth in the Upper Valley core. Table 2.4 shows total housing statistics for Route 4 corridor communities between 1980 and 2004.

TABLE 2.4

Total Housing Units						
Town	**Year**				**% Change**	
	1980	1990	2000	2005 (est.)	1980 to 1990	1990 to 2005
Lebanon	4,758	5,173	5,707	6,325	8.7%	**22.3%**
Enfield	1,541	2,158	2,372	2,564	**40.0%**	**18.8%**
Canaan	1,118	1,435	1,588	1,743	28.4%	**21.5%**
New Hampshire	386,381	503,904	547,024	596,263	30.4%	18.3%

Sources: 1980, 1990, and 2000 U.S. Census Data; New Hampshire Office of Energy and Planning "Current Estimates and Trends in New Hampshire's Housing Supply"

As Table 2.4 shows, between the years 1980 and 1990, the City of Lebanon saw a total increase of only 8.7% in total housing units, whereas the Town of Enfield saw a 40% increase in total housing units over the same period. Similarly, the Town of Canaan saw a nearly 30% increase in housing stock. In part, the housing shortage resulted from an "employment boom" in the Upper Valley, with employment growth rates significantly higher than the state average (*Mayberry, New Hampshire Housing Needs Study, 2003*). The Lebanon housing shortage combined with increasing employment in the Upper Valley seems to have sparked the growth seen in Enfield and Canaan over the past 25 years. Since the relocation of the Dartmouth-Hitchcock Medical Center in 1990, the City of Lebanon has significantly increased its development of new housing units, while Enfield and Canaan have continued to develop new housing at nearly the same rate. Over the past 15 years, all three communities within the Route 4 corridor study area have developed new housing at rates higher than the State of New Hampshire average.

As a result of the Lebanon housing shortage, the character of the Route 4 corridor has significantly changed. The towns of Enfield and Canaan (and to a lesser extent Grafton and Orange) have developed into bedroom communities serving the Upper Valley employment center, with Route 4 becoming a significant commuter route. This is evidenced in Figure 2.4(B), which shows the work-related commute patterns for U.S. Route 4 communities.

FIGURE 2.4(B)

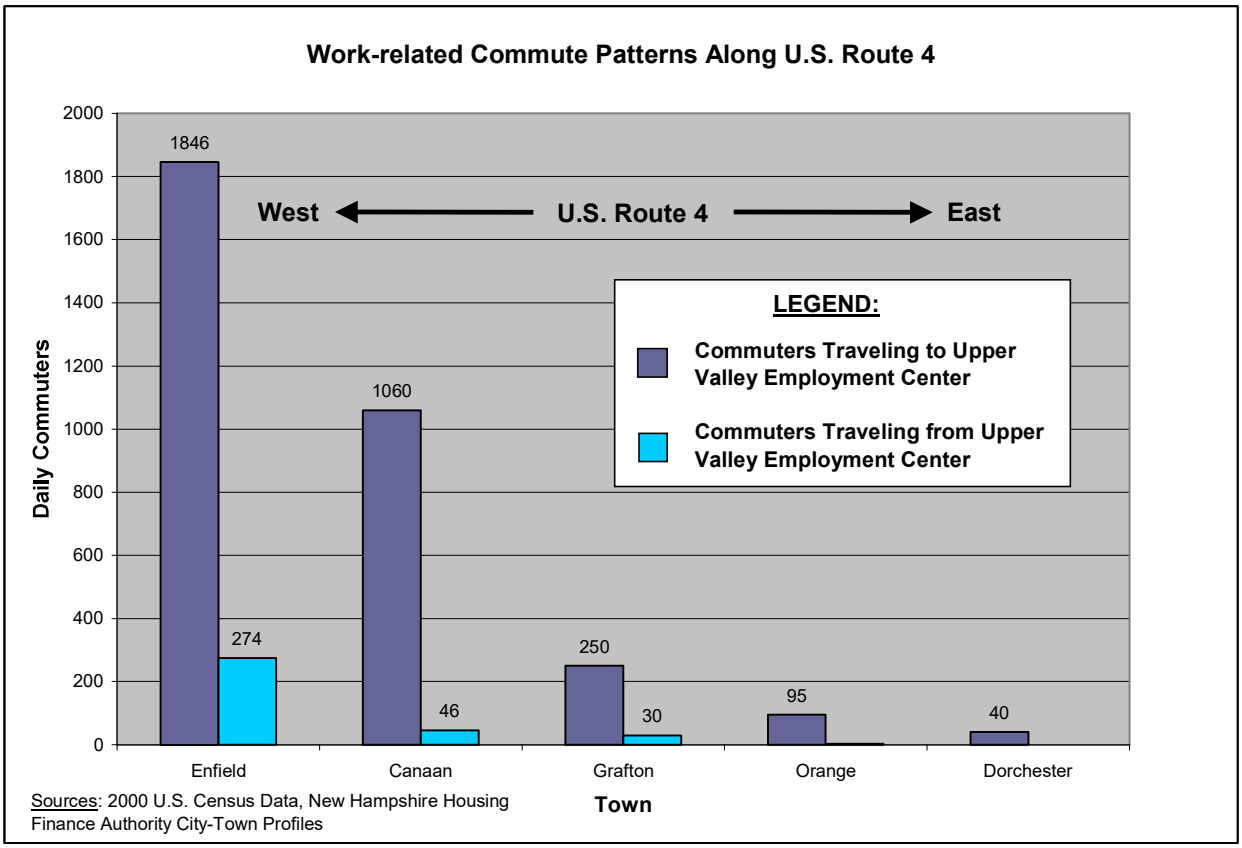


Figure 2.4(B) displays the disproportionate commute patterns along the corridor, showing the extent of the Route 4 commutershed (Existing Zoning Map - Appendix A) and the relationship between the towns therein. Moving from west to east, the commutershed begins in Enfield and ends in Dorchester. The vast majority of workers begin their commute from either Enfield or Canaan, and work in the Upper Valley employment center of Lebanon-Hanover-Hartford. Figure 2.4(B) supports the theory that the towns of Enfield and Canaan act as "bedroom communities" for the Upper Valley employment centers and lends further insight into how demographic and economic factors have played a role in shaping the Route 4 corridor.

3.0 Future Conditions

3.1 Future Roadway Conditions

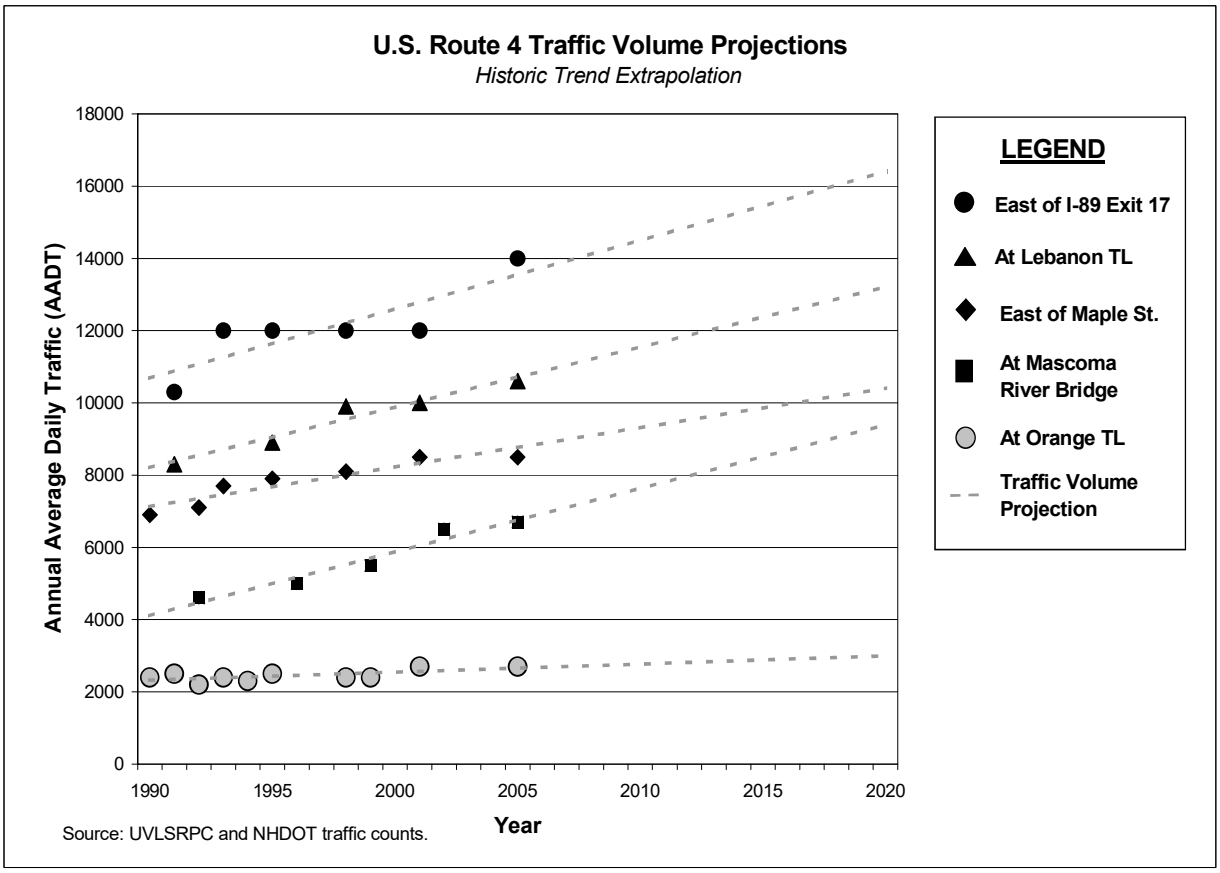
A travel demand projection is a tool used to predict future conditions along a roadway or within a road network. Travel demand projections are developed from actual travel behavior observations, which may include traffic counts and origin-destination surveys. There are many methods of developing traffic demand projections, including travel demand modeling, trip generation/attraction analysis, and historic trend extrapolation. The method used depends on the scope of the analysis as well as

available data and technical resources. Currently, there is no regional travel demand model or origin-destination survey in place for the Upper Valley Lake Sunapee region. However, historic traffic count data is available at many points within the 12-mile long study area.

The availability of historic traffic count data allows for the use of a trend extrapolation analysis to project future traffic volumes. The result is a travel demand model in its simplest form: a regression equation. Although the trend extrapolation method is easily applied, it has a number of significant drawbacks. The primary drawback is rigidity. The trend extrapolation method considers all factors influencing demand to remain constant over time. Any significant change to the roadway itself (e.g. capacity increases) or the land use surrounding it (e.g. zoning changes) may result in changes in travel demand which are not accounted for in the trend extrapolated model. Similarly, any significant changes to demographic (e.g. population shifts) or economic factors (e.g. fuel prices) may also result in travel demand shifts, which cannot be accounted for in the trend extrapolation method.

To add flexibility to the travel demand projections developed for U.S. Route 4, an historic trend extrapolation analysis was conducted in conjunction with an annual compound growth rate analysis. The latter applies an annual percentage growth rate to the most recent traffic count data available. Similar to interest in a bank account, traffic volume growth is projected as a compound accumulation. Whereas the historic trend extrapolation method generally projects growth linearly, the annual compound growth method projects an exponential growth trend. The historic trend extrapolation method provides a “lower-growth” scenario, while the annual compound growth method provides a “higher-growth” scenario. The analyses use historic traffic count data dating from 1990 to 2005, and project annual average daily traffic (AADT) volumes to the year 2020. The results of the analyses are presented in Figure 3.1.

FIGURE 3.1



Note: Although traffic counts were not conducted concurrently with roadwork on Route 4, some counts referenced in Figure 3.1 may have been conducted concurrently with roadwork on parallel or alternate routes.

As Figure 3.1 shows, historical traffic count data from five key locations within the 12-mile long study area were plotted and linear regression performed. In total, five counts were chosen for the trend extrapolation analysis ranging from the eastern extent of the study area at the Canaan/Orange town line to the western extent of the study area east of I-89 exit 17. Important locations within the town of Canaan (the Mascoma River Bridge crossing), the town of Enfield (East of Maple Street), and the city of Lebanon (the Lebanon/Enfield town line) were also included in the analysis. Taken together, these five locations provide a good cross-section of traffic patterns along the Route 4 corridor study area.

Figure 3.1 shows a number of general traffic trends along the Route 4 corridor. As one would expect, traffic volumes steadily increase moving from east to west along the study area. The Canaan/Orange town line at the eastern boundary of the study area currently sees the lowest traffic volumes, and the western boundary of the study area at the I-89 exit 17 interchange currently sees the highest volumes. Traffic volumes progressively increase moving from the town of Canaan, through the town of

Enfield, and into the city of Lebanon. The historic trend extrapolation analysis indicates that this pattern will continue over the next 15 years.

The projections indicate that traffic volumes in the towns of Canaan and Enfield will continue to grow significantly. In the town of Canaan, a sharp increase in traffic is projected at the Mascoma River Bridge crossing. The trend extrapolation analysis projects that this location will see traffic volumes increase to over 9,200 vehicles per day by the year 2020. Similarly, in the town of Enfield, traffic volumes east of Maple Street are projected to increase to over 10,300 vehicles per day by the year 2020. Interstate 89 will continue to attract increasing traffic volumes along Route 4; however, the trend-extrapolated projection provides a very conservative estimate of future traffic volume adjacent to the exit 17 interchange of approximately 16,200 vehicles per day. Although this location sees the highest traffic volumes in the study area, the projection predicts an increase of only 2,200 vehicles per day between 2006 and 2020 (a 1.05% average annual increase). This relatively low projection is the result of a number of factors.

Primarily, this results from the “flat-line” traffic counts between 1993 and 2001. During this period, traffic counts held steady at 12,000 vehicles per day. However, between 2001 and 2005, traffic volumes east of I-89 exit 17 increased from 12,000 to 14,000 vehicles per day- a sharp increase of nearly 17% over the period. When linear regression was performed, the long period of steady traffic volumes may have skewed the forecast, resulting in a slightly lower projection. However, this station was the only instance where the “flat-line” data effect occurred. For this reason, it is anticipated that future traffic volumes at the I-89 interchange may actually be higher than projected by the trend extrapolation method. Detailed results of the trend extrapolation analysis, including 5, 10, and 15 year interval projections, can be found in Table 3.1(A).

TABLE 3.1(A)

Projected Traffic Volumes Along U.S. Route 4 Corridor *(Historic Trend Extrapolation)*				
Traffic Count Location	**Annual Average Daily Traffic (AADT)**			
	2005	**2010**	**2015**	**2020**
	Observed	*← Projected →*		
East of I-89 Exit 17	14,000	14,255	15,267	16,222
At Lebanon TL	10,600	11,380	12,216	13,052
East of Maple St.	8,500	9,207	9,754	10,302
At Mascoma River Br.	6,700	7,462	8,345	9,228
At Orange TL	2,700	2,746	2,858	2,970

As mentioned, a compound annual growth analysis was conducted in addition to the trend extrapolation analysis. The compound growth method is another common

means of projecting future traffic volumes, and applies an annual percentage growth rate to existing traffic counts. Because the method results in exponential growth forecasts, the selection of an appropriate annual percentage growth rate is very important. A growth rate that is even slightly too low or too high will result in traffic volume projections that are unrealistic. Other corridor studies within the state have assumed a 2% annual growth rate (*Nashua & Southwest RPC, NH 101 Corridor Plan, 1999*). However, using the coefficients of the regression models presented, a corridor-wide annual growth rate of 2.2% was determined and applied to the Route 4 study area. The results of the compound growth analysis are presented in Table 3.1(B).

TABLE 3.1(B)

Projected Traffic Volumes Along U.S. Route 4 Corridor *(Compound Annual Growth Analysis)*					
Traffic Count Location	**Compound Annual Growth Rate**	**Annual Average Daily Traffic (AADT)**			
		2005	**2010**	**2015**	**2020**
		Observed	← *Projected* →		
East of I-89 Exit 17	2.2% per year	14,000	15,609	17,404	19,404
At Lebanon Town Line	2.2% per year	10,600	11,818	13,177	14,692
East of Maple St.	2.2% per year	8,500	9,477	10,566	11,781
At Mascoma River Bridge	2.2% per year	6,700	7,470	8,329	9,286
At Orange Town Line	2.2% per year	2,700	3,010	3,356	3,742

As expected, the compound growth projections indicate higher projected traffic volumes than the historic trend analysis, especially in the towns of Canaan and Enfield. Traffic at the Mascoma River Bridge crossing is projected to reach 9,200 vehicles per day by 2020. In the town of Enfield, traffic volumes east of Maple Street are projected to rise to over 11,700 vehicles per day by the year 2020. Traffic volumes along the approach to I-89, at the Lebanon-Enfield town line, and the I-89 exit 17 interchange are also forecasted to increase sharply, with the exit 17 interchange projected to see over 19,400 vehicles per day. The 2.2% annual growth figure was also applied to the approaches of five key intersections in the study area to project future levels-of-service.

1) Route 4/Route 4A, Enfield
2) Route 4/High Street, Enfield
3) Route 4/Maple/Main St., Enfield
4) Route 4/Depot/Canaan St., Canaan
5) Route 4/Route 118, Canaan

Morning and afternoon peak period level-of-service analyses were conducted at five-year intervals for each intersection. Projections were developed for the years 2010,

2015, and 2020. Tables 3.1(C) and 3.1(D) show the detailed results of the AM and PM peak period level-of-service analyses.

TABLE 3.1(C)

Intersection Approach Level-of-Service Summary- AM Peak Period*					
Intersection		**AM Peak Period (6:45-8:45 AM)**			
		Northbound	Southbound***	Eastbound	Westbound***
Route 4/Route 4A					
	Current	***F***	A	A	A
	2010	***F****	A	B	A
	2015	***F****	A	B	A
	2020	***F****	A	B	A
Route 4/High St.					
	Current	***E***	N/A	A	A
	2010	***F***	N/A	A	A
	2015	***F****	N/A	A	A
	2020	***F****	N/A	A	B
Route 4/Maple/Main St.					
	Current	C	B	A	A
	2010	C	B	A	A
	2015	C	C	A	A
	2020	D	C	A	A
Route 4/Depot/Canaan St.					
	Current	B	B	A	A
	2010	B	B	A	A
	2015	C	C	A	A
	2020	C	C	A	A
Route 4/Route 118					
	Current	N/A	A	A	N/A
	2010	N/A	B	A	N/A
	2015	N/A	B	A	N/A
	2020	N/A	B	A	N/A

** Level-of-Service projections developed using HCS2000 Version 4.1c*
***Projected volume-capacity (v/c) ratio greater than 1.0.*
****During turning movement counts at the intersection of Route 4/Route 4A in the AM peak period, no vehicles were observed executing turning movements from the southbound or westbound approaches. By default, these approaches were deemed to be at LOS A.*

The level-of service projections indicate that, during the morning peak period, there are three problematic intersections in the study area. By 2010, the intersection of Route 4 and High Street in Enfield will reach LOS F, indicating that northbound travelers will face “Extreme Congestion”. The intersection of Routes 4 and 4A, which has already reached LOS F, will continue to worsen, resulting in gridlock for northbound traffic. Additionally, the Route 4/Maple/Main St. intersection in Enfield is projected to reach LOS D (“Above Average Congestion”) in the northbound direction by 2020. This intersection should be considered an area of growing concern, and should be closely monitored. All other turning movements are projected to perform relatively well in the morning peak period. Level-of-service projections were also

performed for the afternoon peak period. The detailed results of the analyses are presented in Table 3.1(D).

TABLE 3.1(D)

Intersection Approach Level-of-Service Summary- PM Peak Period*					
Intersection		**PM Peak Period (3:45-5:45 PM)**			
		Northbound	Southbound	Eastbound	Westbound
Route 4/Route 4A					
	Current	***F***	B	A	B
	2010	***F****	B	A	B
	2015	***F****	B	A	B
	2020	***F****	B	A	B
Route 4/High St.					
	Current	C	N/A	A	A
	2010	D	N/A	A	A
	2015	***E***	N/A	A	B
	2020	***F***	N/A	A	B
Route 4/Maple/Main St.					
	Current	C	D	A	A
	2010	D	***F***	A	A
	2015	***F***	***F***	A	A
	2020	***F****	***F****	A	A
Route 4/Depot/Canaan St.					
	Current	B	B	A	A
	2010	B	B	A	A
	2015	B	C	A	A
	2020	B	C	A	A
Route 4/Route 118					
	Current	N/A	B	A	N/A
	2010	N/A	C	A	N/A
	2015	N/A	C	A	N/A
	2020	N/A	C	A	N/A

** Level-of-Service projections developed using HCS2000 Version 4.1c*
***Projected volume-capacity (v/c) ratio greater than 1.0.*

As Table 3.1(D) shows, the afternoon peak period level-of service projections indicate that are three problematic intersections in the study area. The intersection of Routes 4 and 4A, which has already reached a failing level-of-service in the northbound direction, will continue to worsen. Second, the intersection of Route 4 and High Street in Enfield, which currently provides an average level-of-service (LOS C) in the northbound direction, is projected to worsen to LOS E by 2015 and reach LOS F by 2020. Third, the intersection of Route 4, Maple and Main Streets in Enfield is projected to reach a failing level-of-service in both the northbound and southbound directions by 2015. All other turning movements are projected to operate at average or above average levels-of-service through the year 2020.

3.2 Future Land Use and Development

Future land use along the Route 4 corridor will have a fundamental impact on the operation, safety, and appearance of the roadway. Communities along the Route 4 corridor should pursue future development that meets their needs and interests; however, care should be taken to ensure that growth does not unnecessarily degrade the capacity of the roadway or detract from community character. All three communities in the Route 4 corridor study area are currently facing land use proposals that will have a direct impact on the future development of the Route 4 corridor.

City of Lebanon

In October 2006, the City of Lebanon Planning Board proposed a zoning ordinance revision that would have had a significant impact on the western extent of the study area. Specifically, the General Commercial (GC) district currently located immediately east of the I-89 Exit 17 interchange would have been eliminated under the proposal. Under the proposal, this area would have become a Residential Medium Density (RM) district. The new Residential Medium Density district would have been similar to the current Rural Lands One district in that its purpose would have been to provide a transition between denser urban areas and more sparsely settled areas (City of Lebanon, Proposed Zoning Ordinance, 2006). This change would have signaled a substantial shift in the city's policy surrounding the I-89 Exit 17 interchange.

This proposal would have essentially curtailed further commercial development at the I-89 Exit 17 interchange. After the October 2006 proposal, there was a significant debate about the proposed zoning changes. Among the debated items was the future of the Exit 17 interchange. Some members of the public expressed a desire to encourage further commercial development around the interchange, while others supported the Planning Board's proposal. In December 2006, the Lebanon Planning Board formally recommended a number of changes to the October 2006 proposal. Those changes included making the existing General Commercial district an "industrial/commercial-limited" district, which would allow both light industrial and commercial development around Exit 17. However, in January 2007, the Lebanon City Council decided not to put the proposed zoning amendment on the 2007 ballot, giving the Lebanon Planning Board time to sufficiently evaluate public comments and review the proposal for re-consideration in 2008.

As the Lebanon Planning Board debates the issues surrounding the I-89 Exit 17 interchange over the coming year, there are a number of important considerations. The I-89 Exit 17 interchange currently experiences the highest traffic volumes in the study area, and further highway-oriented commercial development would almost certainly exacerbate existing congestion at the intersection. Allowing or encouraging more intensive land uses around the Exit 17 interchange will significantly impact traffic all along Route 4, not only in Lebanon, but in Enfield and Canaan as well. The I-89 Exit 17 interchange will play an important role in the future of the Route 4

corridor, and moving forward, encouraging land use and development patterns that maintain the efficiency of traffic operations throughout the corridor will be crucial.

Town of Enfield

The Town of Enfield recently created a Tax Increment Financing (TIF) district for their Community Business zone, which encompasses the Route 4 corridor adjacent to Enfield village (Enfield Tax Increment Finance District Map - Appendix A). Tax Increment Finance districts use tax revenues in a designated redevelopment area to encourage private development to occur. In Enfield, all property tax revenue resulting from increases in the value of the properties in the district are placed into a special allocation fund, which is used to pay for the costs of infrastructure improvements. In its first year, Enfield's TIF district recovered a tax increment of nearly $16,000 for infrastructure improvements (*Town of Enfield, Annual Report, 2005*). The long-term development impacts resulting from Enfield's TIF district remain to be seen. However, the town should strive for development that minimizes impacts on traffic flow and maintains the continuity and character of its village setting.

Town of Canaan

The Canaan Planning Board has proposed a zoning ordinance for approval at the March 2007 Town Meeting. There are two districts in the proposed ordinance that would directly affect the Route 4 corridor: the Village District and the Commercial Corridor district. Specific characteristics of each zoning district are detailed in Table 3.2(A).

Village District

The Canaan Planning Board has proposed that the Canaan village area, which encompasses Route 4 in the vicinity of the Route 4/Canaan/Depot Street and Route 4/Route 118 intersection be designated as a part of a Village district. According to the proposed Zoning Ordinance, the purpose of the Village district is to "preserve historic village patterns of development; promote the renewal of existing urban areas; encourage a mix of land uses that are compatible and that support the local economy; guide commercial, light industrial, and high-density growth into the Villages, while still retaining the small-town character; provide a pedestrian-friendly environment by promoting and use patterns that are not wholly dependent on vehicular transportation; and discourage strip development" (*Town of Canaan, Proposed Zoning Ordinance, 2006*). Permitted uses in the Village district include single and multi-family residential, retail stores, service businesses, banks, and restaurants.

Commercial Corridor District

The proposed Commercial Corridor district would essentially encompass all of Route 4 not included in the Village district. The Commercial Corridor district would extend 500 feet from the right-of-way centerline along Route 4, and is intended to

"concentrate commercial and industrial uses so as to minimize traffic in residential neighborhoods" (*Town of Canaan, Proposed Zoning Ordinance, 2006*). Permitted uses include retail stores, service businesses, banks and restaurants.

TABLE 3.2(A)

Selected Characteristics of Proposed Canaan Zoning Ordinance			
Proposed Zone	**Front Setback**	**Frontage**	**Minimum Lot Size (Sq. Ft.)**
Village District	25'	75'	10,000
Commercial Corridor	25'	100'	40,000

The proposed zoning ordinance is an important first step toward regulating land use in the Town of Canaan. Clearly, the zoning ordinance would have significant impact on the Route 4 corridor. While the proposed Village district promotes uses and densities that reflect the town's commitment to preserving the character of the Canaan village area, care should be taken to ensure that the Commercial Corridor district does not promote strip-style development along Route 4, which would decrease the capacity of the roadway and detract from community character.

Development Potential

Prior to the development of this corridor management study, the UVLSRPC completed build-out analyses for each of the three communities in the Route 4 study area. A build-out is "a planner's reference to a hypothetical point in the future when all land that can be developed has been developed" (*UVLSRPC, Build-out Analysis for Lebanon, NH: A Determination of the Maximum Amount of Future Residential and Nonresidential Development Possible Under Current Zoning, 1999*). Build-out analyses are intended to provide communities an understanding of development potential given their land use regulations and natural development constraints.

The build-out analyses conducted for the three Route 4 corridor communities primarily focused on future residential development, and sought to determine the following:

- How many new lots could be developed under current land use regulations
- How future growth would be distributed
- How many dwelling units new lots would represent
- How much the population would increase

The build-out analysis for the City of Lebanon was conducted in 1999, for the Town of Enfield in 2001, and for the Town of Canaan in 2004. Key results from the build-out analyses are presented in Table 3.2(B).

TABLE 3.2(B)

Key Results from Build-out Analyses				
Town	**Current Housing Units (2005 est.)**	**Number of Dwelling Units Estimated at Build-out**	**Current Population (2005 est.)**	**Population Estimated at Build-out**
City of Lebanon	6,325	14,004	13,421	30,550
Town of Enfield	2,564	4,089	4,857	9,395
Town of Canaan	1,743	13,645	3,518	28,449

4.0 Specific Issues Facing the Route 4 Corridor

4.1 Issue #1 Existing Infrastructure Deficiencies

Perhaps the most tangible issues facing the Route 4 corridor are related to deficiencies in the roadway's existing infrastructure. The nature of current deficiencies falls into three groups: capacity-related, safety-related, and environmental concerns (Road Safety Audit Map - Appendix A).

Capacity-Related Deficiencies
Traffic demands have increased significantly along Route 4, especially in the most western portion of the corridor where traffic volumes are the highest and congestion the greatest. Mitigating these capacity-related deficiencies will be difficult with traditional infrastructure improvements because the corridor is restricted in the amount of state Right-of-Way available. Steep topographic changes and other natural constraints such as wetlands, flood prone areas, and conserved lands also pose challenges to improvements that consume additional land.

Safety-Related Deficiencies
Limited right-of-way is also a factor in terms of safety. Safety issues include poor sight distances due to topography, encroaching development and infrastructure, and the lack of pedestrian facilities. Some improvements require immediate attention, while others could be completed as resources allow or when other improvements are made. Some problems may have less-than-perfect solutions given the high cost of mitigation, and some could be easy fixes as part of regular maintenance.

Environmental Concerns
There are inevitable consequences to a major travel route bisecting a community and passing by homes and businesses. Many residents report the noise from traffic as bothersome. Surface water runoff and air pollution from the roadway affect wildlife

populations and contribute to environmental degradation. An especially important concern is the impact of runoff on both Mascoma Lake and the Mascoma River, the drinking water supply for the City of Lebanon. The Route 4 corridor also crosses a number of wetlands that support waterfowl, reptiles and amphibians, and is in close proximity to deer wintering areas. The Mascoma Watershed Conservation Council (MWCC) identified an area inclusive of most of the Route 4 corridor study area as their primary conservation focus area. Four locations within this focus area were further identified as "investigation" areas for their high value as wildlife habitat. Most of the land in this focus area is unprotected. The MWCC has further identified a known wildlife corridor, which crosses either over or under Route 4 by the Black Water Road Bridge, connecting the Webster Wildlife Management Area to the wetland area south of it.

Needs:

Capacity and Infrastructure

- Perform proactive maintenance of existing infrastructure
- Create sidewalks and other supporting infrastructure in priority areas

Safety

- Increase shoulder width throughout the corridor and develop safe pull-off areas for disabled vehicles
- Mitigate conflicts with trees, utility poles, and mailboxes in clear zone
- Maintain clear pavement markings
- Improve sight distances in areas of steep topography

Environmental

- Maintain good air quality
- Improve stormwater management, drainage, and erosion control to reduce non-point source pollutants
- Reduce the noise impacts associated with traffic
- Reduce roadway impacts on native wildlife populations

Recommendations:

Capacity and Infrastructure

Address Tangential Infrastructure Needs within the Scope of Other Roadwork

The upcoming Ten Year Plan project to reconstruct the Route 4 Bridge over the Mascoma River will be crucial in addressing existing infrastructure deficiencies along the Route 4 corridor. This project should address alternative capacity improvements to the Route 4/Route 4A intersection and should seek to improve sight distances for traffic turning from Route 4A onto Route 4. The intersection of Route 4/Route 4A will

be discussed in further detail in Issue 2; however, it is important to address tangential infrastructure needs incrementally within the scope of other roadwork efforts. The upcoming reconstruction of the Mascoma River Bridge should also address the continual erosion problems along the Mill Road.

Develop a Schedule for Proactive Infrastructure Maintenance

The communities along Route 4 should continue to monitor areas with emerging congestion problems, including the intersections of Route 4/Main Street and Route 4/High Street. Also, communities should work cooperatively with the NHDOT to develop a proactive maintenance schedule for the corridor. For instance, retaining walls should be included in this maintenance schedule. For example, the retaining wall along Route 4 east of Enfield village is in need of repair. A proactive maintenance schedule will help to prolong the useful life of infrastructure and reduce the need for costly reconstructions.

Create Sidewalks and Other Supporting Infrastructure in Priority Areas

To facilitate pedestrian travel in the villages of Enfield and Canaan, sidewalks and other supporting infrastructure should be constructed. Public meetings identified the lack of adequate pedestrian facilities in a number of locations in the study area. Primarily, well demarcated crosswalks and sidewalks should be constructed in the following areas:

- Connecting Enfield's Main Street and new commercial development to the east, terminating at the Enfield House of Pizza
- Connecting Canaan Village to Canaan School Street
- Along the east side of Main Street in Enfield between the Police Station and U.S. Route 4 (in front of Mascoma Bank & Huse Park)

The need for sidewalks and other facilities that support alternative modes of transportation will be discussed in further detail in Section 4.4. However, it is important to mention that, in addition to supporting alternative modes of transportation, sidewalks can create continuity within a community.

Safety

Develop a Consistent Shoulder Throughout the Corridor

The New Hampshire Department of Transportation should work to create a consistent shoulder along the roadway. Shoulder width should be no less than 4 feet. Shoulders along Route 4 would have three key impacts. First, shoulders will improve the operational efficiency of the road by allowing drivers to navigate around left-turning vehicles. This will help to preserve the flow of traffic in areas where no left turn pockets exist. Second, shoulders serve important safety roles by providing safe places for disabled vehicles to pull out of the flow of traffic, and also by providing areas for emergency vehicles to bypass congestion. Third, shoulders provide a safe

area for cyclists to travel. Because right-of-way along the Route 4 corridor is by prescription (i.e., historic continued public use), no comprehensive information about the availability of right-of-way is available. Notwithstanding, the NHDOT should use available right-of-way along the corridor to facilitate the construction of new shoulders.

Relocate Objects in the Clear Zone as Part of Future Roadwork Efforts

While working to create a consistent shoulder width throughout the roadway, the NHDOT should also work with communities and local landowners to relocate objects in the clear zone. The clear zone is the "total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles" (*AASHTO, Roadside Design Guide, 1996*). The recommended width of a clear zone is dependent on a number of factors, including traffic volumes, the functional classification of a roadway, and available right-of-way. However, along the Route 4 corridor, there are many areas in which trees, utility poles, and mailboxes directly abut the roadway. Relocating these objects away from the roadway surface would increase safety by allowing drivers who stray from the roadway an adequate area to regain control of their vehicles.

Environmental

Protect Wildlife and Wildlife Habitat

Communities should work cooperatively with the New Hampshire Fish and Game Department and Department of Transportation to explore methods of protecting wildlife along the Route 4 corridor. There are many relatively inexpensive methods of protecting wildlife along the roadway including:

1) Providing additional signage to warn drivers that they are in the vicinity of known wildlife crossings;
2) Installing culverts that allow reptiles and amphibians to cross the road safely;
3) Mowing only the extent of the right-of-way, as studies have shown that animals are attracted to mown grasses and vegetation;
4) Reducing the speed limit in areas known to be animal crossings.

Communities should also consider permanently protecting the wetland habitat and associated uplands south of the Webster Wildlife Management Area for waterfowl, reptile and amphibian species. As part of this process, the Town of Enfield should review its zoning ordinance, and if necessary, revise their wetlands overlay district to give greater protection to wetland habitat areas. Similarly, should the Town of Canaan enact a zoning ordinance, provisions should be made that protect wetlands and known wildlife areas.

4.2 Issue #2 Congestion at Key Intersections

Throughout the development of this study, input from public meetings and from the Route 4 Advisory Committee identified congestion and safety issues at key intersections throughout the study area as among the most important issues facing the corridor. The issues arising at intersections are the direct result of the emergence of Route 4 as a commuter corridor and the increasing traffic volumes resulting therefrom. How Route 4 corridor communities choose to deal with the emerging congestion issues at these intersections will play a major role in the future development of the roadway.

Needs:

- Improved levels-of-service at key intersections
    - I-89 Exit 17 interchange
    - Route 4/ Route 4A
    - Route 4/High St.
    - Route 4/Maple/Main St.
- Better intersection design
- Improved intersection geometry
    - Route 4/Maple/Main St.
    - Route 4/Route 118
- Increased safety

Recommendations:

<u>Study Alternative Capacity Improvements for Key Intersections</u>

Traditional intersection capacity improvements are costly. They involve the acquisition of additional right-of-way and the construction of additional lanes, but don't provide long-term solutions to the problem of congestion. A better approach is to complete a series of alternative capacity improvements to problematic intersections within the study area. Alternative capacity improvements seek to reduce the number of traffic conflict points at an intersection while maximizing the use of the intersection's existing capacity. Used in conjunction with comprehensive Access Management and Travel Demand Management programs (discussed in Issues 2 and 3), alternative capacity improvements can have a dramatic effect on the Route 4 corridor.

I-89 Exit 17 Interchange

The I-89 Exit 17 interchange currently sees the highest traffic volumes in the study area and has been an area of increasing concern. The yield condition for vehicles exiting from I-89 southbound has made it difficult for vehicles exiting from I-89 northbound to enter the traffic stream. This has resulted in vehicles backing up onto the highway during peak periods. There are occasionally times, even with an existing

yield condition, when vehicles exiting from I-89 southbound cannot find gaps in Route 4 traffic. At times, this also causes back-ups onto the interstate.

These issues should be addressed as part of the upcoming Ten Year Plan project to resurface I-89 between exits 15 and 17. There are a number of possible alternative capacity improvements for this interchange. One involves removing the yield condition for vehicles exiting from I-89 southbound. Placing a stop sign here would open up gaps for vehicles exiting from I-89 northbound to enter the traffic stream, but may result in increased back-ups for vehicles exiting I-89 southbound. A second possibility would be to combine the two left turn pockets serving the interchange with the two left turn pockets serving Riverside Drive and Stoney Brook Road. This would result in a continuous turning lane, and may improve the level of service of the interchange. A third option would be to signalize the highway off-ramps. However, the NHDOT should evaluate other potential alternative capacity improvements to the interchange as part of the "preliminary design phase" of the upcoming Ten Year Plan project.

Route 4/Route 4A Intersection

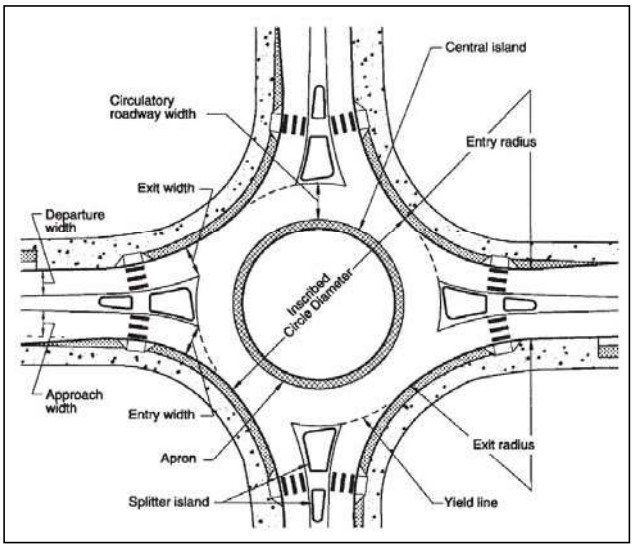
In terms of congestion, the Route 4/Route 4A intersection is the most problematic in the study area. The level of service for traffic turning from Route 4A onto Route 4 is already failing, and as traffic volumes grow along the corridor, the intersection will continue to worsen. As mentioned in Issue 1, the upcoming Ten Year Plan project to reconstruct the Route 4 Bridge over the Mascoma River should include alternative capacity improvements to the Route 4/Route 4A intersection. These improvements should include realignment of the intersection and sight distance improvements for traffic turning from Route 4A onto Route 4.

Realigning the Route 4/Route 4A intersection would improve sight distances for traffic on Route 4A.

During the development of this study, the Ten Year Plan Project to reconstruct the Mascoma River Bridge went into the preliminary design phase. According to NHDOT District Engineer Alan Hanscom, the Route 4/Route 4A intersection improvements will occur as part of the bridge reconstruction project. The NHDOT Bureau of Highway Design is currently investigating methods of realigning the intersection and controlling erosion along the slope between Mill Road and Eastman Hill Road.

Route 4/Maple/Main Street

Congestion at the intersection of Route 4/Maple/Main Street in Enfield is becoming increasingly problematic. As discussed in Section 3.1, levels-of-service at the intersection will continue to deteriorate. Within 5 years, the southbound approach to the intersection is projected to reach LOS F in the afternoon peak period. By 2015, both the northbound and southbound approaches to the intersection are projected to reach LOS F in the afternoon peak period. As travel demand in the Enfield village area continues to grow, eliminating the access from Route 4 to Huse Park could help to reduce congestion.



Source: "Roundabouts: An Informational Guide", FHWA Turner-Fairbank Highway Research Center, 1999

Alternative capacity improvements could also help to maximize the efficiency of the intersection. The Town of Enfield should work with the NHDOT to consider constructing a roundabout at the intersection. A roundabout at the Route 4/Maple/Main Street intersection would offer the following benefits:

1) Maximizes the use of existing capacity by ensuring that traffic is constantly moving;
2) Handles moderate to large traffic volumes easily;
3) Slows traffic, resulting in fewer accidents;
4) Improves air quality by reducing stop-and-go traffic;
5) Increases roadway aesthetics by providing landscaping opportunities.

Route 4/Route 118

Although recent Transportation Enhancement projects have improved the intersection of Route 4 and Route 118 in Canaan, there remains a significant turning radius issue. Specifically, there is a sharp turning radius for westbound traffic on Route 4 turning onto Route 118. This sharp turning radius is a significant safety issue, and has made it virtually impossible for large vehicles to execute turns from Route 4 westbound onto Route 118. As a result, large vehicles may be using alternate routes to access communities along Route 118.

To turn onto Route 118 from Route 4 westbound, vehicles must use a town-owned road, High Street, which acts as a connector between the two arterials. Thus, improving the turning radius could result in significant costs for the town, especially if right-of-way must be purchased. The Town of Canaan is aware of the issues related to the Route 4/Route 118 intersection and has established a committee to review the

problem and make recommendations as to how to address the issues. While doing so, the town should work cooperatively with the NHDOT to explore methods of improving the geometry of the intersection while minimizing costs.

Perform Signal Warrant Analyses at Key Intersections in the Corridor

As congestion increases across the corridor, the levels-of-service provided at key intersections in the study area will continue to deteriorate. Alternative capacity improvements can help to alleviate congestion, improve safety, and increase operational efficiency along the corridor. However, there is a clear need to study the congestion and safety issues at key intersections in greater depth. Specifically, signal warrants should be conducted at four intersections in the study area: the I-89 Exit 17 interchange, the Route 4/Route 4A intersection, the Route 4/High Street intersection, and the Route 4/Maple/Main St. intersection. As this is primarily an exercise in traffic engineering, communities along the Route 4 corridor should work cooperatively with the NHDOT in this process. The data collected and analyzed as part of the traffic signal warrant process could also be used to determine the applicability of alternative capacity improvements, including roundabouts.

It is important to note that as part of another project, Resource Systems Group, Inc. of White River Junction, Vermont recently performed a traffic signal warrant analysis for the intersection of Route 4/Route 4A. The company found that the intersection does not currently warrant a traffic signal. However, moving forward, the City of Lebanon should work cooperatively with the New Hampshire Department of Transportation to monitor the intersection and periodically conduct additional signal warrant analyses in the coming years.

4.3 Issue #3 Future Growth and Development

Land development is the primary force affecting travel demand in the Route 4 corridor. The development occurring in the Upper Valley employment center (Hartford-Lebanon-Hanover) is beyond the control of Enfield and Canaan. However, being that the Route 4 corridor predominantly supports commuter traffic to the Upper Valley employment center, this development has a significant impact on these communities in terms of increased traffic volumes and congestion. With an increasing number of workers in the Upper Valley seeking housing options further away from employment, transportation demand along the Route 4 corridor will continue to grow. Moreover, as the communities of Enfield and Canaan pursue their own development interests, they will also contribute to increasing travel demand. For instance, a recent proposal to construct 144 condominium units adjacent to Route 4 in Enfield would result in hundreds of additional vehicle trips per week. Shaping growth so that it supports the efficient use of existing capacity and supports alternative transportation modes will be critical to the future management of the corridor.

Land use and transportation are inextricably linked. Land development patterns and site design significantly impact travel demand and traffic patterns. If development is

excessive in quantity and/or poor in site design, access to Route 4 will become more problematic, resulting in less efficient use of the existing capacity.

Needs:

- Continued emphasis on residential development in the Lebanon-Hanover-Hartford employment center
- Development of comprehensive access management policies and more efficient site circulation
- Retroactive access improvements in key areas
    - Enfield Post Office vicinity
    - Brookside Plaza vicinity
    - Mascoma Regional High School vicinity
    - Canaan Expressmart vicinity

Recommendations:

Communities situated along Route 4 should work together to develop a comprehensive Access Management Program for the corridor. The New Hampshire Department of Transportation defines Access Management as "a community working together with State and local agencies to balance the needs of motorists traveling the roadway with the needs of property owners accessing the roadway" (*NHDOT, Access Management, 2001*). Typically access management programs include regulating the spacing and design of driveways, medians, traffic signals, and intersections as necessary to maximize the safe and efficient function of a roadway. The Transportation Research Board, in conjunction with the Federal Highway Administration, has developed 10 "Principles of Access Management" (*TRB Committee ADA70, Principles of Access Management, 2006*). Taken together, these principles may serve as a starting point for communities along the Route 4 corridor to develop policies that strive to meet the goals of access management. As part of this study, the UVLSRPC analyzed the 10 Principles of Access Management, and has determined a number of ways in which these principles may be applied to the Route 4 corridor.

Principle #1: Provide a Specialized Roadway System

Roadway specialization refers to "using each individual roadway facility to perform the desired function of access or movement" (*FHWA, Access Management, Location, and Design, 2000*). It is this simple yet fundamental concept that guides the development of all access management policies: that a road should not be used for a purpose that was not intended. Route 4 is a minor arterial under the statewide transportation system. Going back to Section 2.1, Route 4, as a minor arterial, has three primary functions:

1) To serve trips of moderate length;

2) To provide access to geographic areas smaller than those served by the highway system;
3) To provide intra-community continuity, but not penetrate identifiable neighborhoods.

It is clear from this definition that Route 4, like all roadways, is intended to both move traffic and provide access. However, the vague wording of the definition raises questions. For instance, what exactly does it mean, "to provide access to geographic areas smaller than those served by the highway system?" Access management policies seek to refine the definition of each functional classification to develop a hierarchy within the road network, with each class of road serving specific access needs.

Principle #2: Limit Direct Access to Arterial Roadways

Arterial roadways serve higher traffic volumes, and like Route 4, are often roadways of regional importance. As mentioned earlier, access management policies seek to refine the definition of each class of roadway. As shown in Table 4.3(A), the Federal Highway Administration has provided guidance as to which types of access should be provided by each functional class of road.

TABLE 4.3(A)

Roadway Classification	Type of Access
Local	• Drives of Individual Dwellings
Minor Collector	• Drives of Individual or Multi-family Dwellings • Drives of Small Stand-Alone Businesses
Major Collector	• Drives of Moderate-size Residential or Commercial Developments
Minor Arterial	• Drives of Large Residential Subdivisions or Commercial Developments
Major Arterial	• Drives of Very Large Mixed-use Developments or Regional/Super Regional Commercial Centers

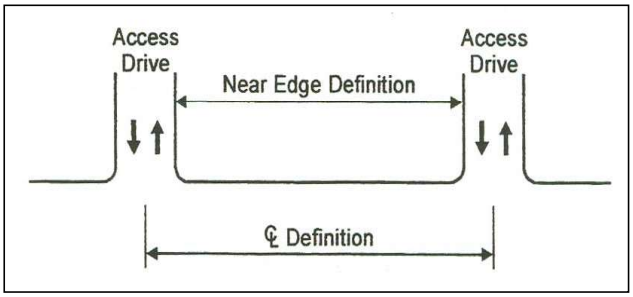
From Table 4.3(A), it is clear that Route 4, as a minor arterial, is only intended to provide access to drives of large residential subdivisions or commercial developments. The road is not intended to provide access to drives of individual dwellings or small stand-alone businesses. However, Route 4 currently provides direct access to dozens of single-family homes in the study area.

By allowing access to individual dwellings and stand-alone businesses, Route 4 is currently serving not only as a minor arterial, but also as a local road. This trend has resulted in congestion, the inefficient use of existing capacity, and serious safety issues. The communities along the Route 4 corridor should work cooperatively with the NHDOT to plan and work toward a goal of making Route 4 a true "arterial road". This is discussed in further detail. However, for large residential subdivisions and commercial developments, access management policies provide a number of techniques for regulating the type of driveway access from arterial roads.

Throughout the Route 4 corridor, serious safety issues have arisen from poorly designed residential accesses.

Reduce the Number of Driveways per Lot

Often, commercial developments have two or more driveways serving their lot when one could easily suffice. Each direct access to an arterial like Route 4 creates a unique set of hazards that drivers must react to while traveling on the road. Reducing the number of driveways per lot results in a safer, more efficient corridor because there are fewer points where drivers must react to vehicles entering and exiting the roadway.



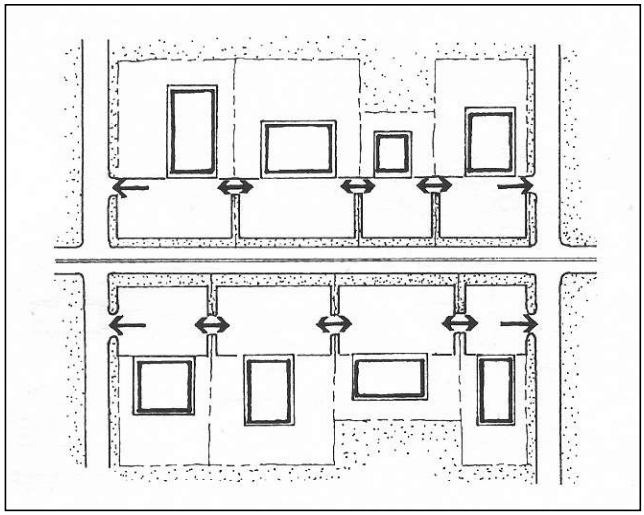
Source: Access Management, Location, and Design, FHWA, 2000

Encourage Shared Driveways

As previously mentioned, there are dozens of single-family homes on Route 4 with direct access to the roadway. Arterial roads like Route 4 should not provide access to individual dwellings; however, access management does provide techniques for reducing the number of roadway accesses for residential sites. Shared driveways allow a single access to serve two or more residential lots, and can reduce the number of residential accesses to a roadway by more that 50 percent.

Encourage the Interconnection of Commercial Developments

Connections between commercial developments allow drivers to access adjacent sites without re-entering the road. Site Plan Review regulations should emphasize the importance of connecting commercial developments, and should provide incentives to developers who designate easements connecting their properties to adjacent sites. The Town of Enfield is currently considering a proposal that would require the interconnection of commercial developments as part of their site plan review process. Commonly referred to as providing "joint or cross access", this technique has four primary advantages (*FHWA, Access Management, Location, and Design, 2000*):



Source: NH Route 16 Access Management Guide, Strafford RPC, 1998

1) Reduces trip length by providing a method of traveling between adjacent commercial developments;
2) Removes some short local trips from arterial roads;
3) Improves the streetscape by increasing the amount of frontage available for landscaping;
4) Allows for improved internal and inter-parcel circulation.

Principle #3: Promote Intersection Hierarchy

The success of access management programs relies heavily on maintaining a hierarchy of facilities, each with its own purpose. This concept extends to intersections as well. Properly designed intersections, for instance the interchange between a limited access freeway and an arterial road, provide a transition from one functional class to another. Communities along the Route 4 corridor should continue to work cooperatively with the NHDOT to plan and design intersections that are appropriate for the corridor.

Principle #4: Locate Signals to Favor Through-Traffic

Although there are currently no signalized intersections in the study area, there remains the possibility that one or more intersections will meet the criteria for signalization in the relatively near future. Signals should be planned to favor the movement of through-traffic along the roadway, and should be laid out in long, relatively uniform intervals. Closely spaced signals not only inhibit the flow of traffic,

but also create significant safety issues. The Federal Highway Administration has identified six distinct advantages resultant from long, uniform signal spacing:

1) Decreases travel time by up to 55% and can decrease traffic delays by up to 50% compared to closely spaced signals;
2) Substantially reduces “Stop and Go” driving;
3) Increases safety and decreases accident rates;
4) Reduces unnecessary fuel consumption;
5) Reduces unnecessary emissions thereby improving air quality;
6) Maximizes the use of the existing intersection capacity.

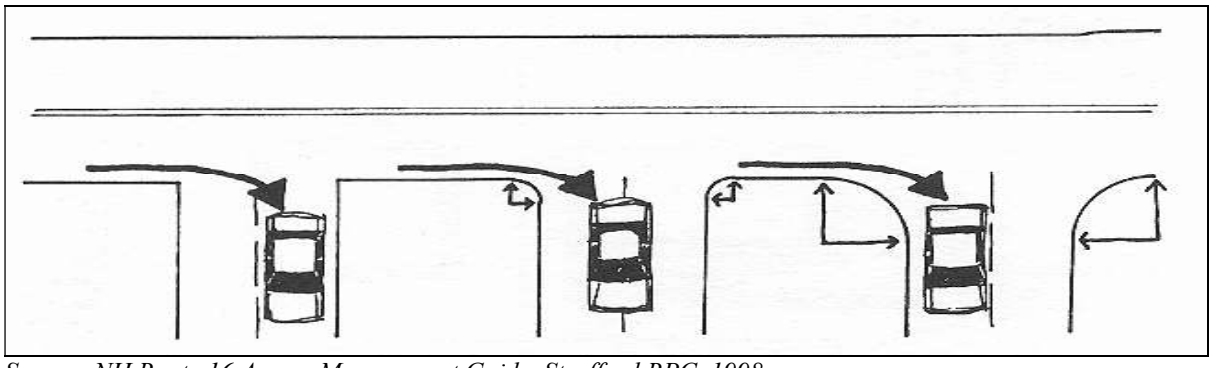
Principle #5: Preserve the Functional Area of Intersections and Interchanges

An important goal of access management is maximizing the use of the existing capacity of a roadway and its intersections. The functional area of an intersection is the area beyond the physical intersection of two roadways that includes decision and maneuvering distance. Preserving the functional area of intersections is an important method of maximizing the use of the existing capacity of a roadway. As mentioned, long, uniform signalized intersection spacing can help to accomplish this task. However, access management provides a number of other techniques for preserving the functional area of intersections and interchanges. One method is providing sufficient turning radii at intersections.

Providing a Sufficient Turning Radius at Intersections

Sufficient turning radii allow drivers to execute turning movements at higher speeds, which, in turn, allows vehicles to exit the roadway more efficiently. A proper turning radius also allows vehicles entering the roadway to accelerate, which reduces back-ups and congestion. Some intersections within the Route 4 corridor study area, such as the intersection of Route 4 and Route 118 in Canaan, do not provide sufficient turning radii. This will be discussed in further detail in Section 5, however, Figures 4.4(A) illustrates how providing sufficient turning radii can help to maximize the efficiency of an intersection.

FIGURE 4.3(A)- TURNING RADIUS DIAGRAM



Source: NH Route 16 Access Management Guide, Strafford RPC, 1998

Principle #6: Limit the Number of Conflict Points

Conflicts occur when traffic paths cross each other. Limiting the number of conflict points builds on the concept of limiting direct access to the roadway. Principle #2 deals primarily with limiting access as a means of mitigating vehicle to vehicle conflicts. This principle of access management, however, deals more with the conflicts between vehicles and pedestrians, bicyclists, and transit. One method of limiting the number of conflict points is to encourage the development of driveways with sufficient throat length.

Encourage Sufficient Driveway Throat Length

The confusion caused by poorly designed commercial driveways results in danger for vehicles, pedestrians, and cyclists. Driveway throat length refers to the depth of the driveway entrance. Sufficient driveway throat lengths help to prevent queues from forming on the roadway while vehicles enter the site. However, not only do driveway throats reduce the number of conflict points on the roadway, they also reduce the number of conflict points within the parking area itself by providing an orderly method of site access and egress.

Poorly designed commercial driveways can increase traffic conflicts within the parking area.

Principle #7: Separate Conflict Areas

Encouraging the adequate separation of conflict points is an especially important concern, not only for efficient traffic flow, but also in terms of safety. On arterial roads like Route 4, where speeds are generally higher, drivers need more time to react to the hazards associated with traffic entering and exiting the traffic stream at each access point. One method of separating conflict areas is requiring a minimum distance between driveways.

Require a Minimum Distance between Driveways

In the most basic sense, requiring a minimum distance between driveways makes driving simpler and reduces the potential for accidents. However, there has been much debate among traffic engineers as to what the minimum distance between driveways should be. In their NH Route 16 Corridor Protection Study, the Strafford Regional Planning Commission (*1998*) recommended the minimum distances presented in Table 4.3(B).

TABLE 4.3(B)

Recommended Minimum Distances Between Driveways	
Posted Speed Limit	**Minimum Spacing**
35 mph	150 Feet
40 mph	185 Feet
45 mph	230 Feet
50 mph	275 Feet

Principle #8: Remove Turning Vehicles from Through-Traffic Lanes

Removing vehicles from through-traffic lanes not only maximizes the use of existing capacity along a roadway, but also increases safety. For an arterial road in a rural setting, like Route 4, creating turning lanes is an appropriate practice. Specifically, left turn pockets for left turning movements and right turn deceleration lanes for right turning movements should be encouraged.

Encourage Left Turn Pockets

Left turn pockets allow drivers to maneuver out of the primary traffic stream when making left turns. As a result, through traffic is unimpeded and may maintain speed while avoiding potential conflict with vehicles turning left. Currently, there are four left turn pockets in the study area, all of which are located in the western extreme of the study area. Two are located at the Route 4/I-89 Exit 17 interchange at the north and southbound on-ramps, and two others are located immediately east of the Exit 17 interchange serving Riverside Drive and Stoney Brook Road.

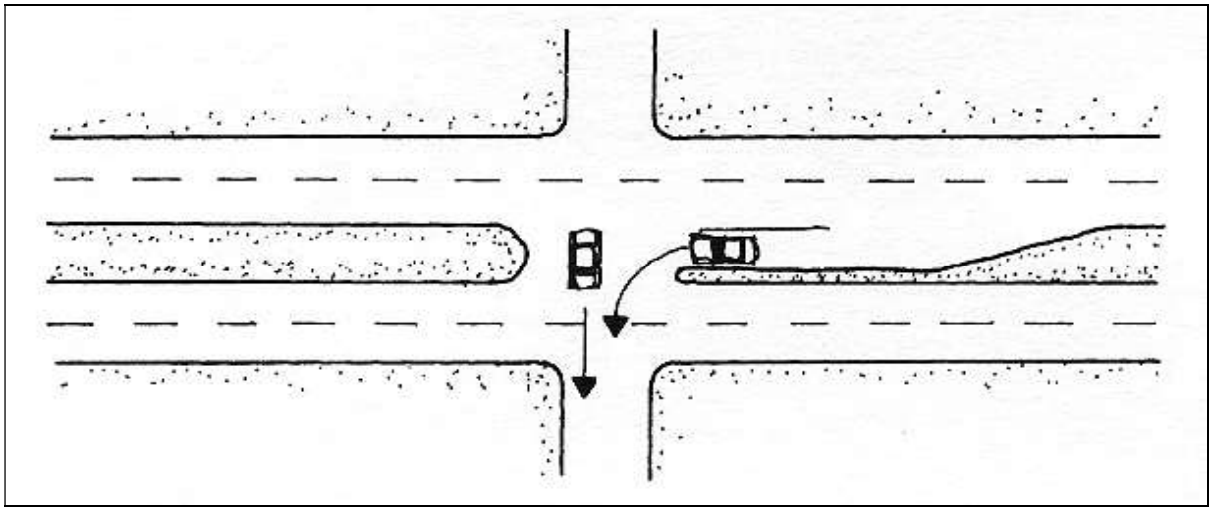
A number of locations in the study area were identified in public meetings as being problematic for left turning vehicles on Route 4 (Study Area Map - Appendix A):

- Turning left onto Ruddsboro Road in Lebanon
- Turning left onto Eastman Hill Road in Lebanon
- Turning left onto Blackwater Road in Enfield
- Turning left onto Goose Pond Road in Canaan
- Turning left onto Switch Road in Canaan
- Turning left onto Roberts Road in Canaan

The Route 4/Switch Road intersection in Canaan may warrant a left turn pocket.

Determining whether these intersections warrant left turn pockets requires turning movement counts. The NHDOT and UVLSRPC should work together to ensure that these turning movement counts be conducted in the near future as part of the regional transportation data collection effort. Upon the completion of data collection, left turn pocket warrants should be conducted for each intersection.

FIGURE 4.3(B)- LEFT TURN POCKET DIAGRAM



Source: NH Route 16 Access Management Guide, Strafford RPC, 1998

Encourage Right Turn Deceleration Lanes

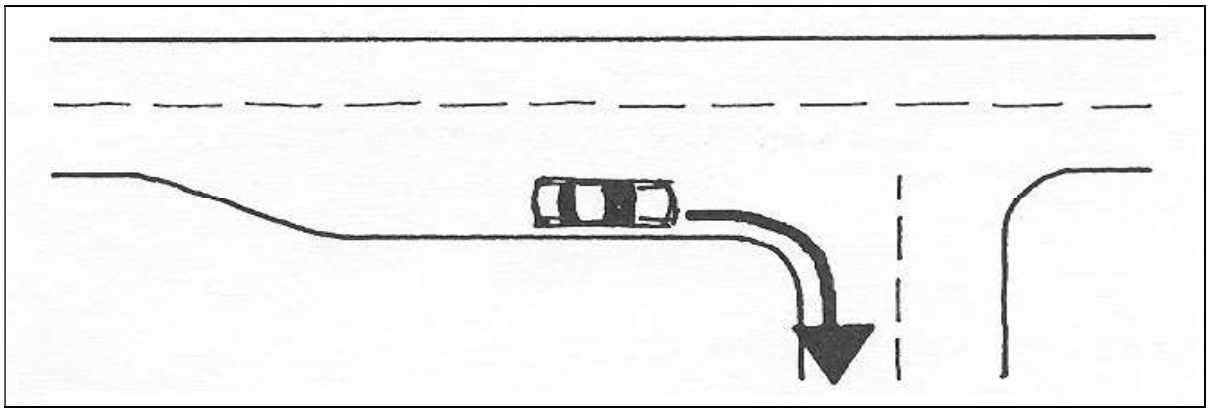
Right turn deceleration lanes allow drivers to maneuver out of the primary traffic stream when slowing to make right turns. Similar to the effect of left turn pockets, right turn deceleration lanes allow through-traffic to flow unimpeded while avoiding conflict with right turning vehicles. Currently, there are no right turn deceleration lanes in the study area. Three locations in the study area were identified in public meetings as being problematic for right turning vehicles on Route 4 (Study Area Map - Appendix A):

The Route 4/Potato Road intersection in Canaan may warrant a right turn deceleration lane.

- Turning right onto Riverside Drive in Lebanon
- Turning right in the vicinity of Barker Steel in Canaan
- Turning right onto Potato Road in Canaan

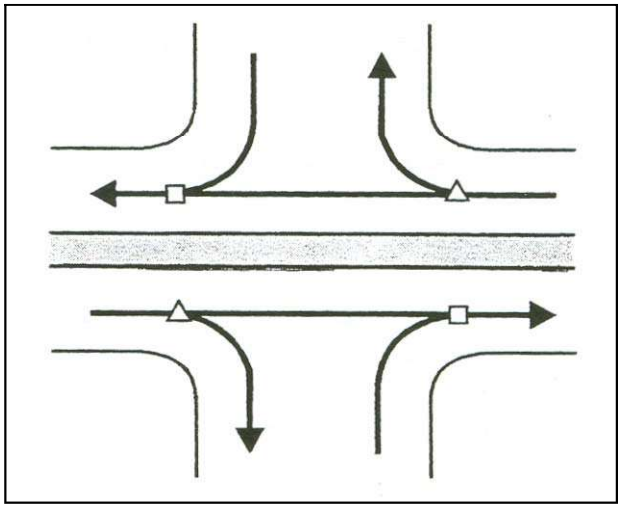
Once again, determining whether these intersections warrant right turn deceleration lanes requires turning movement counts. The NHDOT and UVLSRPC should work together to ensure that turning movement counts are conducted at these intersections as part of the regional transportation data collection effort. When the data has been collected, right turn deceleration lane warrants should be conducted for each location.

FIGURE 4.3(C)- RIGHT TURN DECELERATION DIAGRAM



Source: NH Route 16 Access Management Guide, Strafford RPC, 1998

Principle #9: Encourage Nontraversable Medians to Manage Left Turn Movements



Source: Access Management, Location, and Design, FHWA, 2000

If not properly planned, left turn movements on undivided arterial roads like Route 4 can be very dangerous. This situation is exacerbated when driveways are closely spaced. There are many access management techniques specifically concerned with managing left turn movements, including left turn pockets and continuous two-way left turn lanes. However, the safest method of dealing with left turn movements is installing nontraversable medians. Currently, there are no nontraversable medians in the Route 4 study area. Indeed, the lack of available right-of-way along the corridor may inhibit the future development of nontraversable medians. Notwithstanding, as traffic volumes and congestion continue to increase along the Route 4 corridor, nontraversable medians should be considered as a means of managing left turn movements. The method

provides a number of tangible benefits (*FHWA, Access Management, Location, and Design, 2000*):

1) Reduces total accident rates by up to 50% compared with an undivided roadway;
2) Allows more traffic to travel through intersections while simultaneously reducing intersection accident rates by up to 25 percent;
3) Reduces pedestrian-vehicular accident rates at intersections by up to 60 percent;
4) Increases pedestrian safety by allowing pedestrians to cross one traffic stream, stop in the median, and cross the other traffic stream safely;
5) Provides a means of streetscape improvement if medians are landscaped.

Principle #10: Provide a Supporting Street and Circulation System

By providing direct access to individual homes and stand-alone businesses, Route 4 is currently performing the functions of a local road. This results not only in congestion, but also creates serious safety issues. A simple, yet fundamental, concept for dealing with this issue is to create a supporting street network to provide smaller-scale access. A well-planned collector and local road circulation system can provide safe and efficient access to single properties, reducing congestion and increasing efficiency along arterial roads. Moreover, a supporting street and circulation system can foster the development of alternative modes of transportation by providing alternate routes for pedestrians and bicyclists. There are many access management techniques that support the development of a collector and local road circulation system, including regulating corner lot access and encouraging frontage roads.

<u>Corner Lot Access</u>

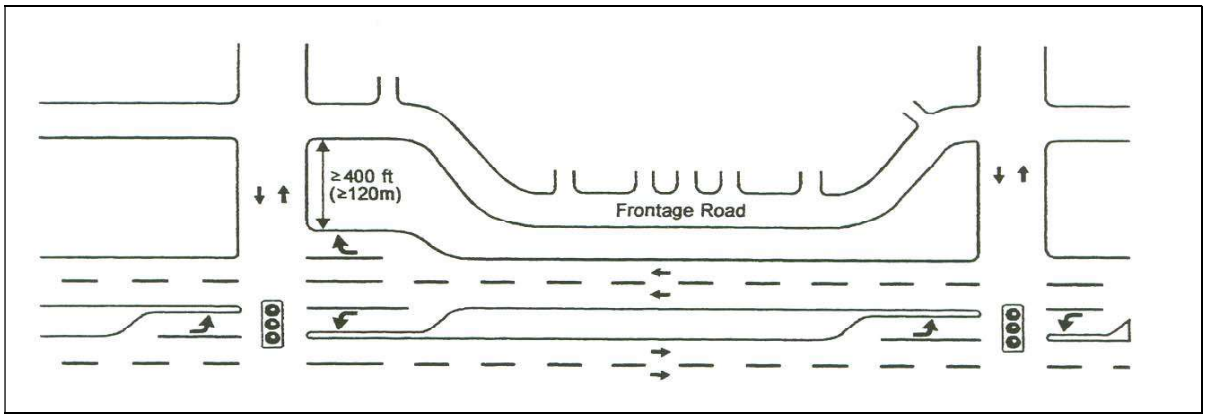
Regulating access to corner lots can help to spur the development of collector and local roads. In most cases, access to corner lots could easily be provided from the adjacent collector road rather that the arterial road, increasing the safety and efficiency of the arterial. Along the Route 4 corridor study area, there are a number of examples of both sound and poor corner lot access management. On the corner of Route 4 and Depot Street in Canaan, the Canaan Art Gallery illustrates sound corner lot access principles, while directly across the street, the Canaan Auto Repair Shop has multiple access points on Route 4 in the proximity of the village's busiest intersection.

The Canaan Art Gallery is an example of sound corner lot access management.

Frontage Roads

A frontage road runs parallel to a major roadway and acts as a collector road serving adjacent lots. Encouraging the development of frontage roads has many benefits. Because businesses located on frontage roads are visible from the arterial roadway, frontage roads allow for the continued commercial development of parcels adjacent to an arterial. By separating local traffic from through-traffic and reducing direct accesses to an arterial roadway, frontage roads can reduce congestion and improve the efficiency of traffic operations along an arterial. One location along the Route 4 corridor where a frontage road might be considered is in the vicinity of Brookside Plaza in Enfield.

FIGURE 4.3(D)- FRONTAGE ROAD DIAGRAM



Source: Access Management, Location, and Design, FHWA, 2000

Next Steps in Implementing an Access Management Program

The New Hampshire Department of Transportation has been very supportive of access management programs in corridors around the state. For example, the NHDOT worked cooperatively with the Town of Bedford to develop a "U.S. Route 3 Policy" (*NHDOT, Access Management, 2001*), which "works toward the goal of developing U.S. Route 3 as a major arterial." Because the NHDOT regulates the issuance of driveway access permits on state highways, and towns regulate the use and development of parcels adjoining the roadway, access management programs must be a cooperative effort between towns along the corridor and the Department of Transportation.

To facilitate this cooperation, the NHDOT has shown a willingness to enter into memorandums of understanding with communities around the state for coordinating highway access management. When implementing a comprehensive access management program, communities along the Route 4 corridor should consider the possibility of entering into a cooperative agreement with the NHDOT. It is important to consider the end results of a comprehensive access management program. In their

NH Route 16 Corridor Protection Study, the Strafford Regional Planning Commission identified 8 very tangible benefits of access management:

1) Increases highway capacity by 25-30%;
2) Extends the functional life of highways by preserving their existing capacity;
3) Reduces the need to spend tax dollars on capacity expansions;
4) Protects the economic viability of parcels adjacent to arterials by preventing congestion that will discourage users from coming;
5) Reduces travel and delay times by 40-60%;
6) Decreases energy consumption by 35-50%;
7) Reduces vehicle emissions by reducing acceleration, deceleration, and stops;
8) Helps to maintain community character.

As previously noted, there are many opportunities along the Route 4 corridor to apply the principles of access management and work toward these goals. Through careful zoning, site plan and subdivision review regulations, and cooperation with the NHDOT, communities along the Route 4 corridor can implement access management techniques and make the Route 4 corridor a safer, more efficient, and more attractive roadway.

4.4 Issue #4 Managing Future Transportation Demand

Transportation demand along the Route 4 corridor has continually increased over the past 15 years, and will continue to increase steadily. As shown in Section 3.1 of this report, some locations within the Route 4 corridor study area may see traffic volumes of nearly 20,000 vehicles per day by the year 2020. These increasing traffic volumes threaten not only the efficiency of traffic operations along the roadway, but also result in serious safety and air quality issues. Moving forward, Route 4 communities will have to work collectively to develop a comprehensive approach to managing transportation demand along the corridor.

Needs:

- Maintain good air quality by reducing emissions
- Minimize the impacts of increasing traffic volumes by continuing to develop viable alternative transportation methods
- Maximize the existing capacity of the corridor

Recommendations:

Communities situated along Route 4 should work together to develop a comprehensive Transportation Demand Management program for the corridor. Transportation Demand Management (TDM) is the process of altering travel behavior to lessen or redistribute travel demand. Typically, this involves reducing or redistributing travel demand during peak use periods. TDM strategies are demand

oriented as opposed to supply (capacity) focused, and may include developing rideshare employer incentive programs that seek to provide alternatives to driving alone. These strategies are implemented within different levels of government and by the private sector, and almost always focus on “home to work” commuters due to their predictable travel patterns. The effectiveness of Transportation Demand Management programs is highly dependent upon the participation of employers.

The chief benefit of Transportation Demand Management programs is that they are less costly to develop and maintain compared to traditional capacity-building measures, which are expensive and encourage additional traffic. This is an especially important factor considering many of the constraints along Route 4. Some employers in the Upper Valley are providing incentives already. For instance, Dartmouth College provides a parking buy-out program for employees and encourages carpooling by providing reserved parking spaces for higher occupancy vehicles. A comprehensive Transportation Demand Management plan incorporates strategies for each of five topic areas (*NHDOT, Travel Demand Management in New Hampshire, 1994*):

1) Improving Alternative Transportation Modes
2) Providing Incentives and Disincentives
3) Encouraging Alternative Work Arrangements
4) Employing Innovative Land Use and Development Strategies
5) Employing Other Targeted Strategies

Improving Alternative Transportation Modes

Developing viable transportation alternatives is the core of transportation demand management. Alternative transportation modes include public transit, carpooling, vanpooling, cycling, and walking. Alternative modes of transportation improve the efficiency of road networks by reducing congestion and providing additional mobility options. Along the Route 4 corridor, there are a number of opportunities to improve transportation alternatives.

<u>Develop New Park and Ride Locations</u>

Transit ridership along Advance Transit’s Blue Route (Route 4) is the highest in the Upper Valley, and has increased nearly 20 percent since 2002. However, there are currently no official park and ride locations along the Route 4 corridor to serve this transit demand. Park and ride lots are parking facilities that allow drivers to transfer out of their vehicles and into transit or shared vehicles. Currently, the Methodist Church in Canaan village is being used as an informal park and ride facility. Given the transit demand along the corridor, there may be need for two park and ride facilities in the study area: one serving Canaan and one serving Enfield. The Upper Valley Transportation Management Association has also identified the need for two park and ride facilities along the Route 4 corridor. Potential locations for new park and ride facilities include:

- The Enfield Community Center (which currently serves as an informal

park-and-ride lot)
- The currently empty lot in the vicinity of the Enfield House of Pizza
- The location of the current Mascoma Valley Regional High School (if the school is to move) in Canaan

Improve Amenities

Alternative transportation modes are supported by a variety of amenities. Providing these amenities may help to encourage the increased use of alternative modes of transportation. Along the Route 4 corridor, the need for these amenities falls under three general categories: transit, pedestrian, and cyclist amenities.

Transit Amenities

The use of public transit can be greatly encouraged by providing bus stop facilities that are user-friendly. Transit stops located near major activity centers and large residential developments should provide the following:

- Enclosed and roofed bus shelters
- Kiosks that include route maps and bus schedules

Pedestrian Amenities

Pedestrians will not travel a roadway unless safe facilities are provided. In the development of this corridor study, public meetings identified the lack of adequate pedestrian facilities in a number of locations in the study area. Primarily, well demarcated crosswalks and sidewalks should be constructed in the following areas:

- Connecting Enfield's Main Street and new commercial development to the east, terminating at the Enfield House of Pizza
- Connecting Canaan Village to Canaan School Street
- Along the east side of Main Street in Enfield between the Police Station and US 4 (in front of Mascoma Bank & Huse Park)

Also, pedestrians wishing to use the Northern Rail Trail, which runs parallel to Route 4, are currently constrained by the limited number of officially designated trail access points. Additional access points should be designated. One potential location for a new rail trail access would be in the vicinity of the Mascoma River crossing adjacent to the McConnell Road in Enfield.

Cyclist Amenities

There is a growing demand for cyclist travel along both the Route 4 roadway and the Northern Rail Trail. However, additional facilities along the corridor would help to encourage an increase in cyclist travel:

- Designating and demarcating an official bicycle lane along the roadway
- Providing additional bicycle storage/parking racks in village areas
- Increasing shoulder width throughout the corridor to make cycling safer
- Providing additional formal access points to the Northern Rail Trail

Maintain an active membership in the UVTMA

Route 4 corridor communities should maintain an active membership in the Upper Valley Transportation Management Association. The UVTMA is an organization comprised of transportation professionals, major employers, and town officials from the core communities of the Upper Valley that seeks to mitigate traffic congestion through the development of viable alternative modes of transportation. Communities should also provide an annual contribution to the UVTMA to support their Transportation Demand Management initiatives throughout the Upper Valley.

Providing Incentives and Disincentives

An important aspect of Transportation Demand Management programs is the provision of financial and nonfinancial incentives to encourage commuters to use alternative modes of transportation. There are three types of incentives that are directly applicable to commuters along the Route 4 corridor: employer-based support programs, parking supply management, and economic incentives.

Employer-based Support Programs

Employer-based support programs "include various strategies collectively implemented as a package by employers or a group of employers, in support of alternative commute modes with the objective of reducing the volume of single-occupant automobiles commuting to a worksite" (*NHDOT, Travel Demand Management in New Hampshire, 1994*). Dartmouth College launched an official Transportation Demand Management policy in 2002, which includes a parking buy-out program for faculty and staff. Route 4 communities should work cooperatively with the Upper Valley Transportation Management Association and local employers to "piggyback" on the efforts of Dartmouth College, and encourage additional employer-based support programs within the region.

Parking Supply Management

Regulating the parking supply in village centers and major public and private traffic destinations can be a disincentive for commuters in single occupant vehicles. According to the New Hampshire Department of Transportation, there are four primary strategies for managing parking supply:

1) Limiting the number of spaces available within a given area;
2) Developing preferential parking policies for high-occupancy vehicles by reserving spaces in preferred locations or by offering a reduced fee in comparison to single-occupant vehicles;

3) Developing parking requirements in zoning codes, including setting maximum and minimum requirements;
4) Establishing pricing controls to discourage peak period travel and single-occupant vehicles.

In the Upper Valley Lake Sunapee region, the Town of Hanover has regulated parking supply by developing pricing controls in the form of metered parking and pay-for-parking lots. This has helped to reduce peak period traffic congestion within the village, encourage increased transit use, and preserve the historic character of Hanover's village center.

Economic Incentives

Economic incentives are already in place in the Upper Valley. The Upper Valley's largest transit provider, Advance Transit, offers a free fare on all of its bus routes in Vermont and New Hampshire. This economic incentive, in large part, has resulted in substantial increases in transit ridership in the region. Advance Transit's free fare is the result of a combination of public and private subsidies, including subsidies from both Dartmouth College and the Dartmouth Hitchcock Medical Center. Route 4 corridor communities should continue their financial support of Advance Transit to keep the free fares available to commuters in the Upper Valley. The success of Advance Transit is indeed a success to the entire region, and is crucial to the development of Route 4 as a vibrant multi-modal corridor.

Encouraging Alternative Work Arrangements

Given the development of Route 4 as a commuter corridor serving the Upper Valley employment center, peak period travel demand along the roadway has increased dramatically. Transportation Demand Management programs also seek to reduce peak period travel demand by encouraging the development of alternative work arrangements. One method of doing so which is directly applicable to the Route 4 corridor is encouraging variable work hours.

Encourage Variable Work Hours

Changing work schedules can provide flexibility in employee travel times and reduce peak period travel demand and congestion. Along the Route 4 corridor, this concept can have a large impact. The three schools in the study area: the Enfield Village School, the Canaan Village School, and the Mascoma Valley Regional High School, generate significant congestion during the morning and afternoon peak periods. Many residents in both Enfield and Canaan have expressed frustration at the level of congestion along Route 4 at the start and end of the school day.

A change in the hours of the school day, even by 15 or 20 minutes, can greatly reduce peak period congestion along Route 4. Not only would this improve the efficiency of travel along the corridor, it would result in safer conditions for children

accessing their schools. For these reasons, the towns of Enfield and Canaan should work with schools to explore the possibility of changing the hours of the school day.

Employing Innovative Land Use and Development Strategies

Land use and development has a fundamental impact on travel demand. There are a number of design strategies that can be employed to discourage the use of single occupant vehicles and encourage the use of transit or other alternative modes of transportation. Primarily, these strategies can be employed through the site-specific design of activity centers.

Site-specific Design of Activity Centers

Because most automobile-oriented developments do not easily accommodate alternative modes of transportation, large activity centers should incorporate the following:

1) Transit-friendly design guidelines;
2) Vanpool and carpool (parking) considerations;
3) Pedestrian and bicycle design considerations;
4) Curb-cut controls;
5) Parking standards and regulation.

Although these strategies are generally applied in areas with higher density residential and employment centers, “transit-oriented design” initiatives can be applied anywhere where there is sufficient transit use. These measures can significantly impact the desirability of alternative modes of transportation in the Upper Valley. Route 4 corridor communities should consider incorporating provisions in their planning and zoning regulations that would permit the use of innovative transit-friendly design.

Employing Other Specially Targeted Strategies

Some Transportation Demand Management strategies are specific to conditions and events in local areas. For the Route 4 corridor, TDM offers a number of strategies for managing the travel demand associated with special events in the region.

Special Event Management

Special events are “occurrences affecting a large number of vehicle trips which occur on a one-time, infrequent, or non-daily basis” (*NHDOT, Travel Demand Management in New Hampshire, 1994*). In the Upper Valley region, travel demand along Route 4 is impacted by a number of special events. These include weekly high school and collegiate sporting events, farmers’ market events, and various plays and concerts. Seasonally, special events impacting the Route 4 corridor include motorcycle week in Laconia and tourists using the corridor for “leaf peeping” activities in the fall. The New

Hampshire Department of Transportation has identified six primary strategies that can be employed to manage the travel demand surrounding special events:

1) Developing a parking management system;
2) Establishing remote parking areas;
3) Providing signage to direct motorists to appropriate routes and destinations;
4) Developing public information and communications systems;
5) Enhancing public transit and/or shuttle services;
6) Increasing police presence;

Through proper planning, short-term spikes in travel demand can be mitigated by implementing one or more of these strategies. Route 4 corridor communities should also consider adopting a standard policy for Transportation Demand Management related to special events.

Next Steps in Implementing a Transportation Demand Management Program

It is important to remember that Transportation Demand Management programs are intended to offer options to commuters. The overall goal is to reduce unnecessary single occupant vehicle trips "without reducing an individual's ability to travel or reducing overall mobility" (*NHDOT, Travel Demand Management in New Hampshire, 1994*). Transportation Demand Management programs work, and have tangible benefits including:

1) Reducing total vehicle miles traveled;
2) Reducing congestion and reducing total vehicle trips;
3) Reducing travel delay;
4) Reducing vehicle emissions thereby improving air quality;
5) Creating more attractive, walkable communities.

Developing a Transportation Demand Management program for the Route 4 corridor must be a cooperative effort between communities, Advance Transit, major employers including Dartmouth College and the Dartmouth Hitchcock Medical Center, the Upper Valley Transportation Management Association, the Upper Valley Lake Sunapee Regional Planning Commission, and the New Hampshire Department of Transportation. Demand management initiatives require funding resources to be effective, but are much less expensive than traditional capacity building measures.

The primary source of funding for transportation demand management programs in New Hampshire comes from the Congestion Mitigation and Air Quality Improvement Program (CMAQ). However, CMAQ funding is only appropriated for areas that are in "nonattainment" of federal air quality standards. In New Hampshire, only the southeastern portion of the state is in nonattainment. Thus, transportation demand management initiatives in the Upper Valley region are not eligible for CMAQ funding.

Moving forward, it is imperative that funding from the state and federal levels become available for transportation demand management initiatives in attainment areas.

5.0 Conclusions

During the development of this study, it became clear that the emerging issues facing the U.S. Route 4 Corridor fell into four categories: deficiencies in existing infrastructure, congestion at key intersections, managing future growth and development, and managing future transportation demand. Effectively addressing the issues facing the Route 4 corridor will require action on each of these four fronts.

This report provides a “four-pronged” approach to dealing with the issues of the Route 4 corridor. First, address existing deficiencies through an approach that preserves capacity, enhances safety, and protects the natural environment. Strategies include maximizing the use of public capital by addressing tangential infrastructure needs within the scope of other roadwork and developing a cooperative and proactive schedule of infrastructure maintenance throughout the corridor.

Second, address congestion at key intersections by employing alternative capacity improvements. Strategies include realigning the intersection of Route 4/Route 4A through the course of other roadwork, and investigating the feasibility of constructing a roundabout to address the issues of the Route 4/Maple/Main Street intersection in Enfield. The traditional approach of “adding two lanes and a stoplight” to a problematic intersection is not only very costly, but doesn’t address the sources of transportation demand. Alternative improvements instead seek to maximize the existing capacity of an intersection while preserving community character.

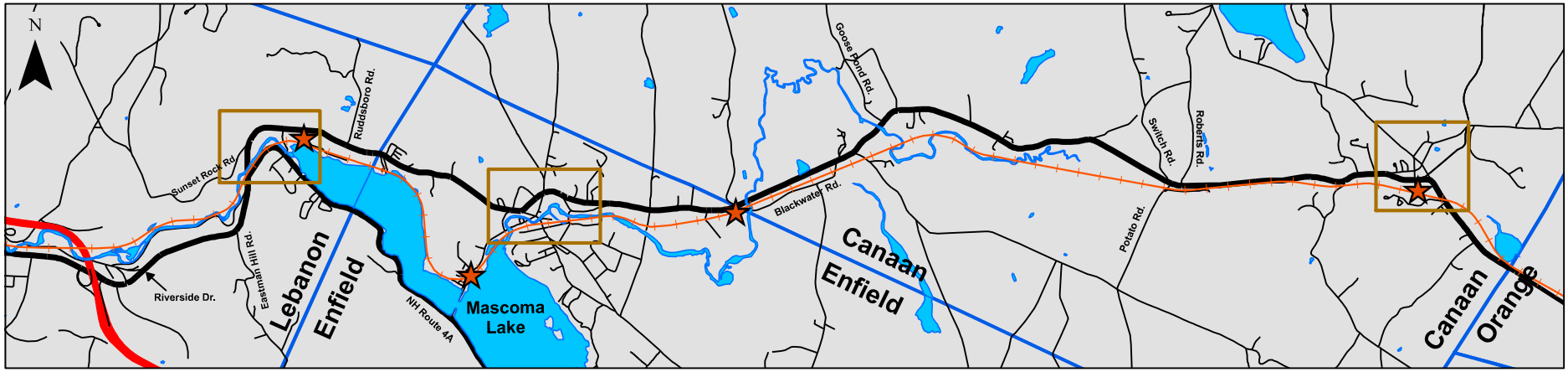
Third, address future growth and development through the development of a comprehensive access management program for the corridor. Access management is more than simply a system of regulating driveways; it seeks to preserve traffic flow by maximizing the efficiency of the roadway. This report has identified over a dozen access management strategies with direct applicability to the Route 4 corridor ranging from regulating a minimum distance between driveways to encouraging the development of left and right turn pockets. The goal of an access management program is not to transform Route 4 into a high-speed limited access thruway, but instead to preserve the character and charm of villages along Route 4 while preserving the efficient flow of traffic and reducing unnecessary congestion.

Finally, addressing transportation demand along the Route 4 corridor at its source by developing a comprehensive travel demand management program will be crucial to the future success of the Route 4 corridor. Moving forward, fostering the continued development of viable public transportation alternatives through financial assistance, developing new park and ride facilities, and providing amenities to encourage additional transit use will be pivotal. Also, building on the economic incentives currently in place and encouraging alternative work arrangements have direct applicability to the Route 4 corridor.

Looking ahead, partnerships will be critical. Comprehensively addressing the issues currently facing the Route 4 corridor will require partnerships between communities and partnerships with the New Hampshire Department of Transportation. Land use and transportation are inextricably linked, and the land development initiated by one community along the Route 4 corridor will impact adjacent communities and the Route 4 corridor as a whole. Certainly, a continuing, coordinated effort between Route 4 corridor communities and the NHDOT to comprehensively plan the future of the corridor is essential.

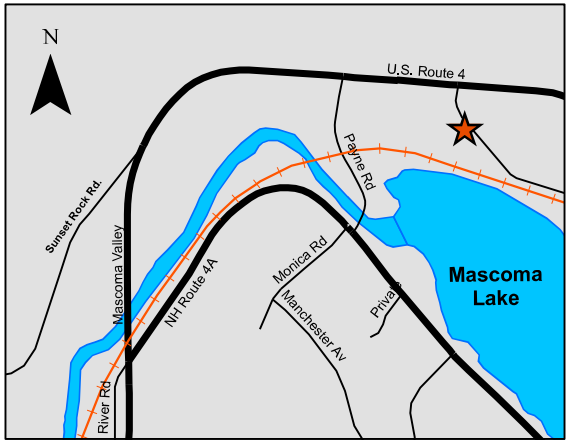
APPENDIX A- PROJECT MAPS

STUDY AREA MAP- U.S. ROUTE 4 CORRIDOR MANAGEMENT STUDY



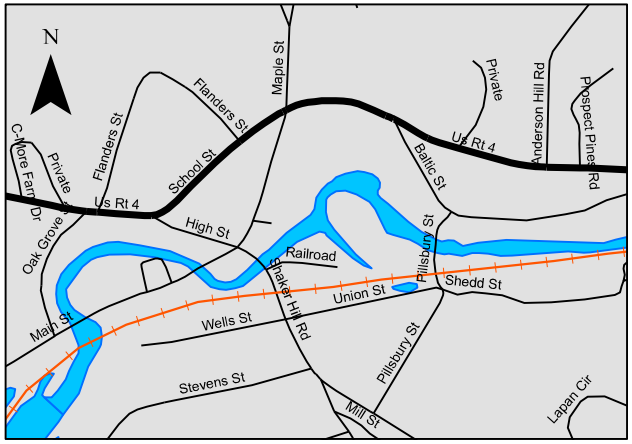
ROUTE 4 CORRIDOR STUDY AREA- LEBANON, ENFIELD, CANAAN

Scale 1:50,000



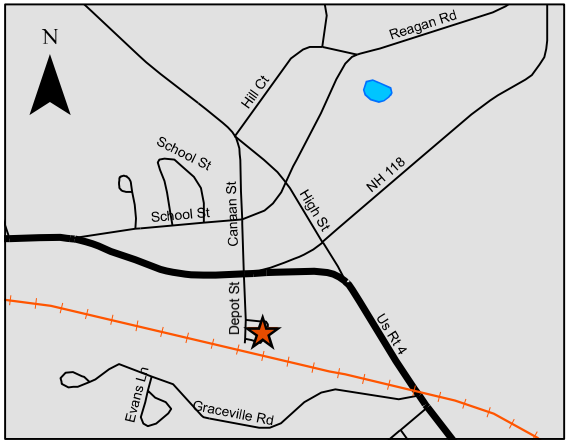
U.S. ROUTE 4/NH ROUTE 4A

Scale 1:10,000



ENFIELD VILLAGE

Scale 1:10,000



CANAAN VILLAGE

Scale 1:10,000

U V L S R P C

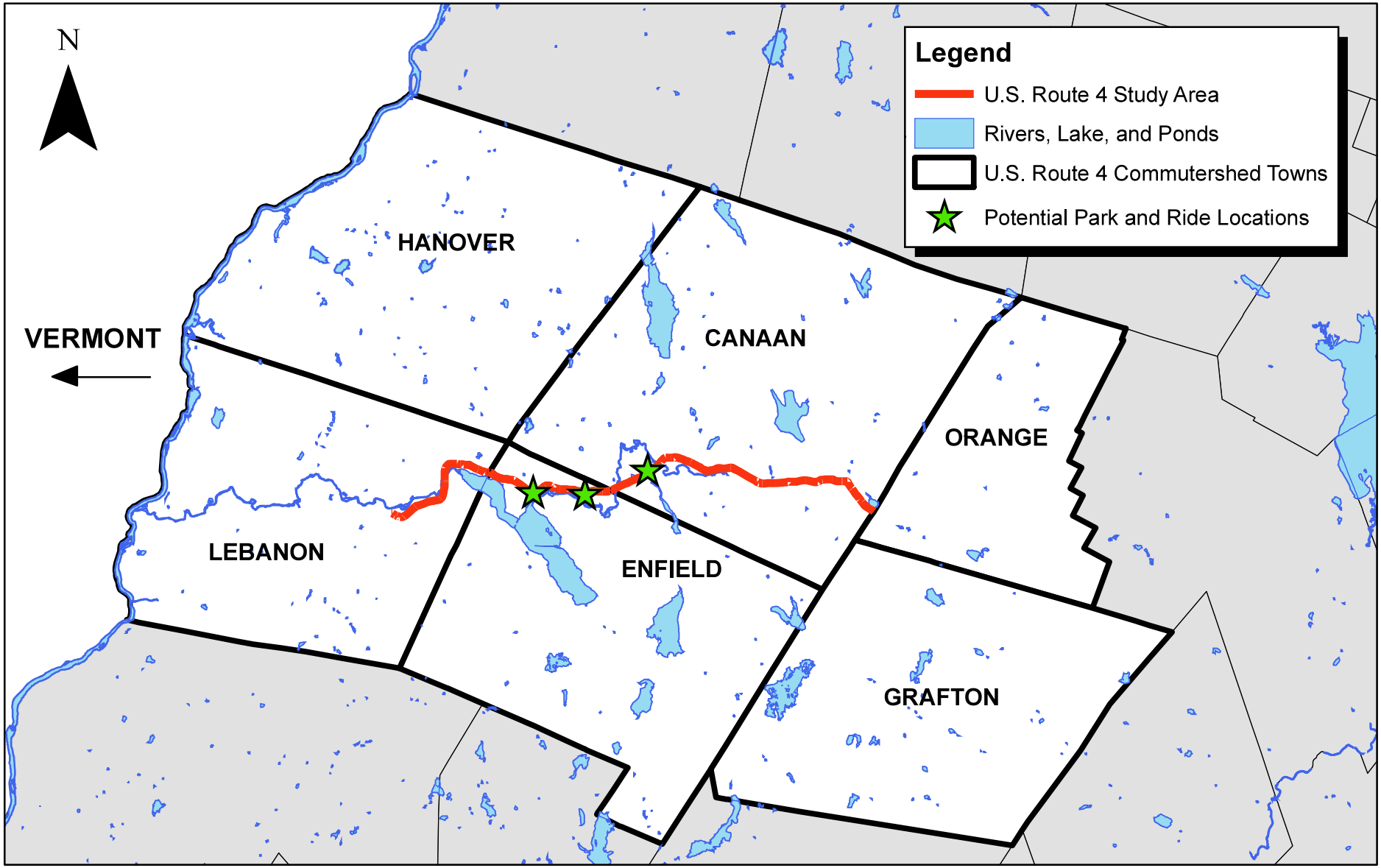
MAP CREATED BY THE UPPER VALLEY LAKE SUNAPEE REGIONAL PLANNING COMMISSION, REVISED JANUARY 2007.

Sources:
Road and rail layers developed by the New Hampshire Department of Transportation. Other base Map features, including water layers, were derived from USGS 1:24,000 scale digital line graphs, distributed by the University of New Hampshire Complex Systems Research Center.

Legend

- Northern Rail Trail
- Rail Trail Access Points
- Rivers, Ponds, and Lakes
- Interstate 89
- U.S. Route 4
- Local Roads
- Town Boundaries

COMMUTERSHED MAP- U.S. ROUTE 4 CORRIDOR MANAGEMENT STUDY

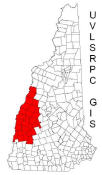


Scale 1:200,000

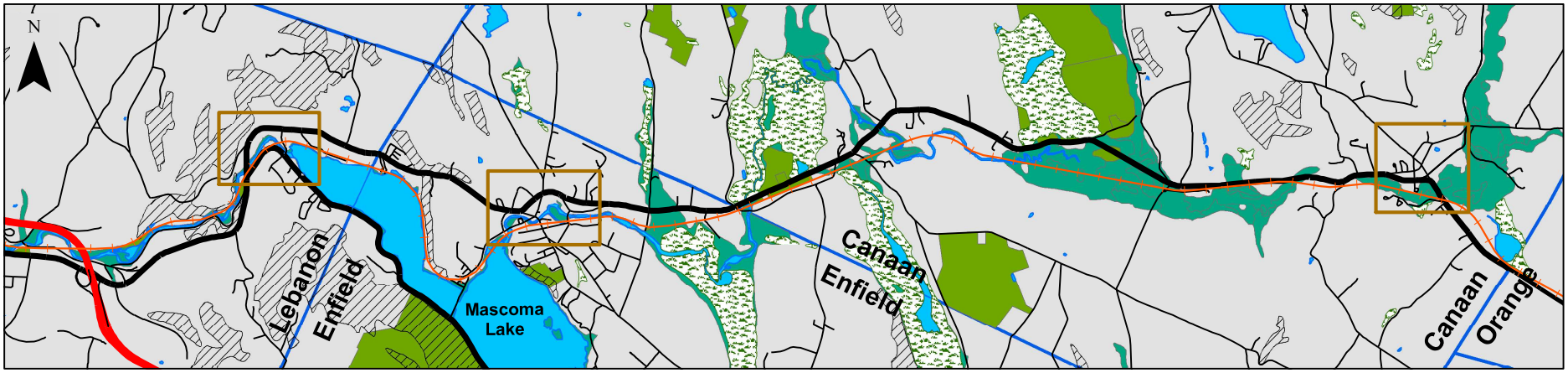
U V L S R P C

MAP CREATED BY THE UPPER VALLEY LAKE SUNAPEE REGIONAL PLANNING COMMISSION, JANUARY 2007.

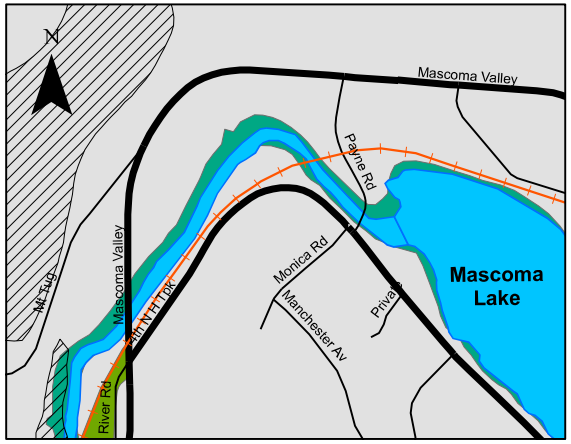
Sources:
Road layers developed by the New Hampshire Department of Transportation. Other base Map features, including water layers, were derived from USGS 1:24,000 scale digital line graphs, distributed by the University of New Hampshire Complex Systems Research Center.



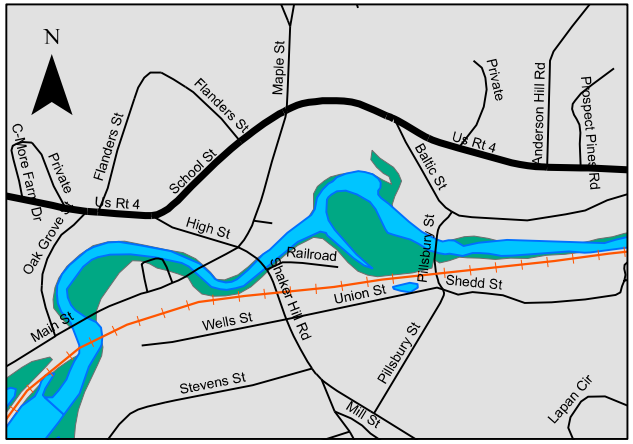
DEVELOPMENT LIMITATIONS MAP- U.S. ROUTE 4 CORRIDOR MANAGEMENT STUDY



ROUTE 4 CORRIDOR STUDY AREA- LEBANON, ENFIELD, CANAAN
Scale 1:50,000



U.S. ROUTE 4/NH ROUTE 4A
Scale 1:10,000



ENFIELD VILLAGE
Scale 1:10,000

CANAAN VILLAGE
Scale 1:10,000

U V L S R P C

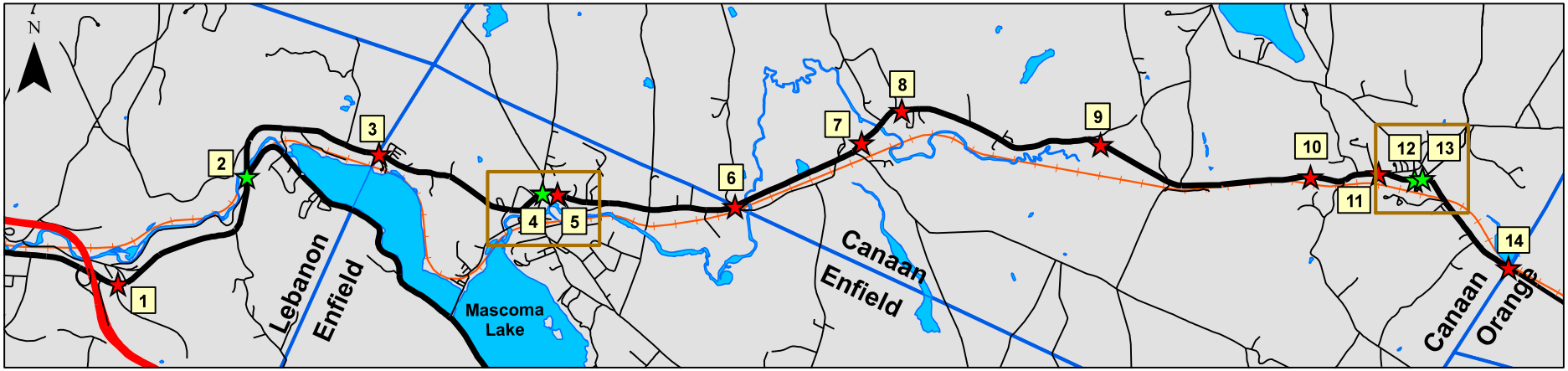
MAP CREATED BY THE UPPER VALLEY LAKE SUNAPEE REGIONAL PLANNING COMMISSION, REVISED JANUARY 2007.

Sources:
Road and rail layers developed by the New Hampshire Department of Transportation. Other base Map features, including water layers, were derived from USGS 1:24,000 scale digital line graphs, distributed by the University of New Hampshire Complex Systems Research Center. Wetlands data provided by the U.S. Fish and Wildlife Service, National Wetlands Inventory (NWI), Distributed by the Complex Systems Research Center, UNH. Slopes greater than 25% digitized by UVLSRPC from USGS topographic maps. Lebanon and Enfield 100-year flood plains digitized by UVLSRPC based on Federal Emergency Management Agency Flood Insurance Rate Maps. Canaan flood zones are frequently flooding soils based on Grafton County soil types mapped by the USDA Natural Resources Conservation Service and digitized by CSRC.

Legend

- Northern Rail Trail
- Town Boundaries
- Interstate 89
- U.S. Route 4
- Local Roads
- Marsh or Swamp
- Rivers, Ponds, and Lakes
- Steep Slopes
- Flood Prone Areas
- Conserved Land

TRAFFIC COUNT LOCATIONS MAP- U.S. ROUTE 4 CORRIDOR MANAGEMENT STUDY

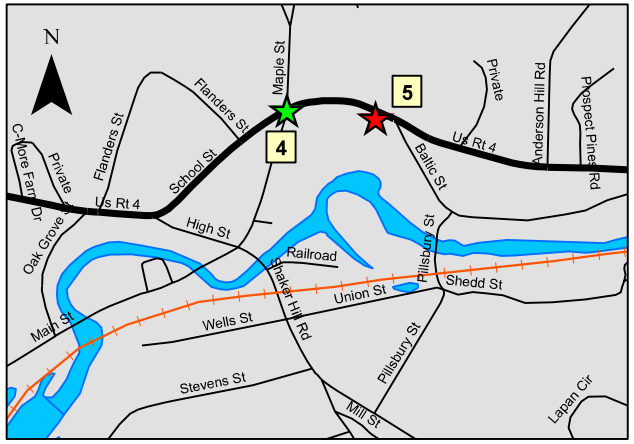


ROUTE 4 CORRIDOR STUDY AREA- LEBANON, ENFIELD, CANAAN

Scale 1:50,000

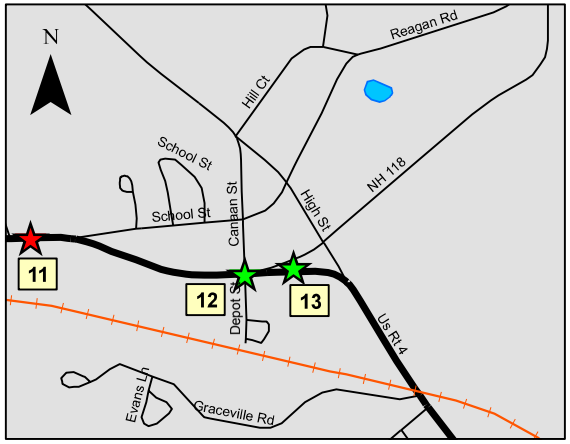
Traffic Count Location Descriptions:

1. U.S. Route 4 East of I-89 Exit 17
2. U.S. Route 4/NH Route 4A Intersection
3. U.S. Route 4 at Lebanon/Enfield Town Line
4. U.S. Route 4/Maple/Main St. Intersection
5. U.S. Route 4 East of Maple St.
6. U.S. Route 4 at Enfield/Canaan Town Line
7. U.S. Route 4 East of South Road
8. U.S. Route 4 East of Stark Hill Road
9. U.S. Route 4 at Mascoma River Bridge
10. U.S. Route 4 West of Gristmill Road
11. U.S. Route 4 East of School Street
12. U.S. Route 4/Canaan/Depot St. Intersection
13. U.S. Route 4/NH Route 118 Intersection
14. U.S. Route 4 at Canaan/Orange Town Line



ENFIELD VILLAGE

Scale 1:10,000



CANAAN VILLAGE

Scale 1:10,000

U V L S R P C

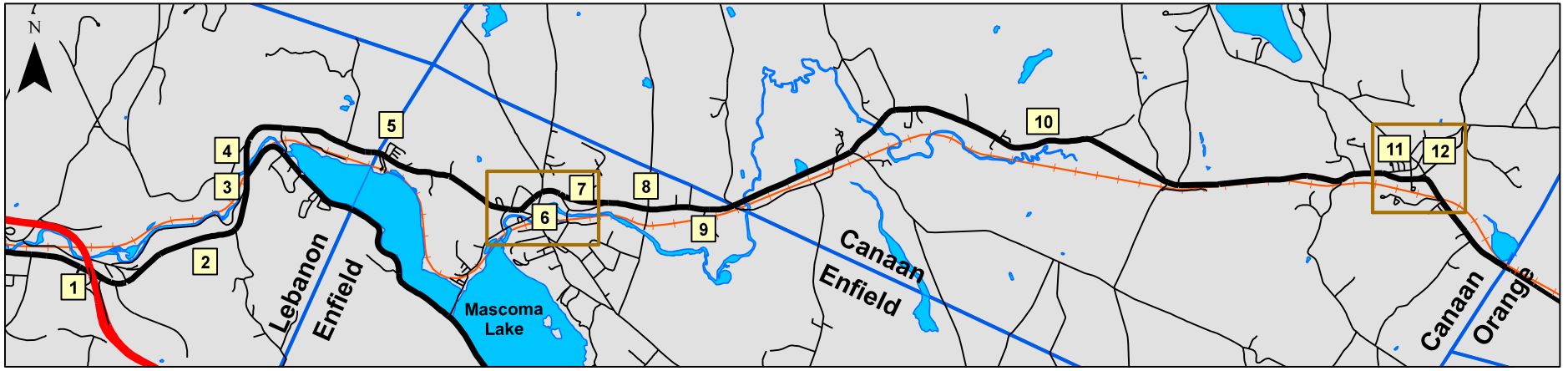
MAP CREATED BY THE UPPER VALLEY LAKE SUNAPEE REGIONAL PLANNING COMMISSION, REVISED JANUARY 2007.

Sources:
Road, rail, and traffic count location layers developed by the New Hampshire Department of Transportation. Other base Map features, including water layers, were derived from USGS 1:24,000 scale digital line graphs, distributed by the University of New Hampshire Complex Systems Research Center.

Legend

- Turning Movement Counts
- Volume Only/Classification Counts
- Rivers, Ponds, and Lakes
- Northern Rail Trail
- Interstate 89
- U.S. Route 4
- Local Roads
- Town Boundaries

ROAD SAFETY AUDIT RESULTS- U.S. ROUTE 4 CORRIDOR MANAGEMENT STUDY

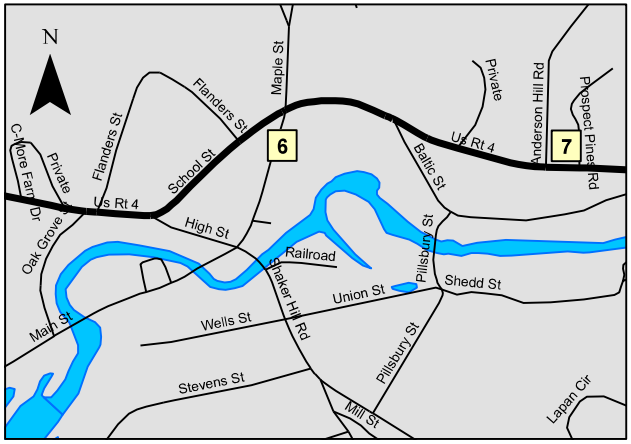


ROUTE 4 CORRIDOR STUDY AREA- LEBANON, ENFIELD, CANAAN

Scale 1:50,000

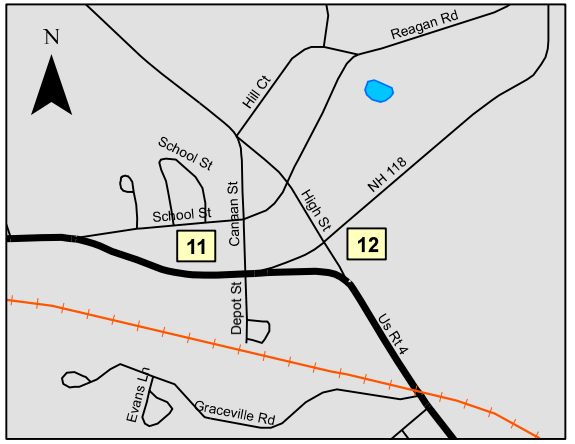
ROAD SAFETY AUDIT CONCERNS:

1. Congestion and Poor Sight Distances at the I-89 Exit 17 Interchange
2. Existing Truck-climbing Lane Ends Abruptly at the Top of a Steep Hill
3. Congestion and Poor Sight Distances at the U.S. Route 4/NH Route 4A Intersection
4. Mill Road is Subject to Erosion Problems and Landslides
5. Poor Sight Distances Around Daniels Mobile Home Park
6. Congestion and Intersection Design Issues at the U.S. Route 4/Maple/Main St. Intersection
7. Poor Sight Distances in the Vicinity of Shaker Valley Auto and Prospect Pines Apartments
8. Retaining Walls in Need of Repair East of Enfield Village
9. Emerging Access Management Concerns in the Vicinity of Brookside Plaza
10. Route 4 is Prone to Flooding East of the Canaan "S-Curves"
11. Lack of Sidewalks between School St. and Canaan Village
12. Poor Turning Radius at U.S. Route 4/NH Route 118 Intersection



ENFIELD VILLAGE

Scale 1:10,000



CANAAN VILLAGE

Scale 1:10,000

U V L S R P C

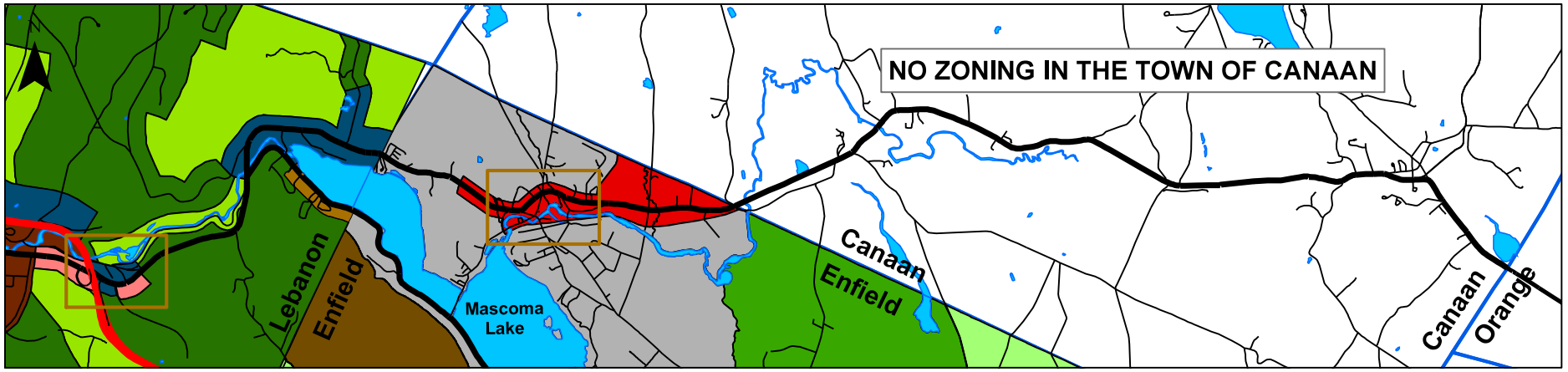
MAP CREATED BY THE UPPER VALLEY LAKE SUNAPEE REGIONAL PLANNING COMMISSION, JANUARY 2007.

Sources:
Road and rail layers developed by the New Hampshire Department of Transportation. Other base Map features, including water layers, were derived from USGS 1:24,000 scale digital line graphs, distributed by the University of New Hampshire Complex Systems Research Center.

Legend

- Rivers, Ponds, and Lakes
- Northern Rail Trail
- Town Boundaries
- Interstate 89
- U.S. Route 4
- Local Roads

EXISTING ZONING MAP- U.S. ROUTE 4 CORRIDOR MANAGEMENT STUDY

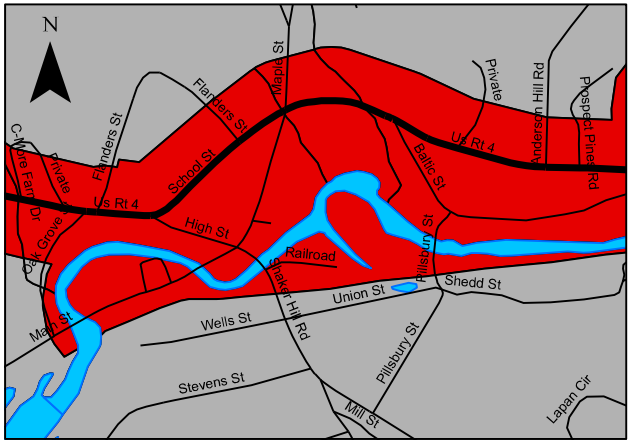


ROUTE 4 CORRIDOR STUDY AREA- LEBANON, ENFIELD, CANAAN

Scale 1:50,000

I-89 EXIT 17 INTERCHANGE

Scale 1:10,000



ENFIELD VILLAGE

Scale 1:10,000

Legend

- Town Boundaries
- Rivers, Ponds, and Lakes
- Interstate 89
- U.S. Route 4
- Local Roads

Enfield Zoning

Zone

- Conservation District
- Community Business
- Residential 1
- Rural Residential 3
- Rural Residential-Agricultural 5

Lebanon Zoning

Zone

- General Comm.
- Neighborhood Comm.
- Residential 3
- Rural Lands 1
- Rural Lands 2
- Rural Lands 3

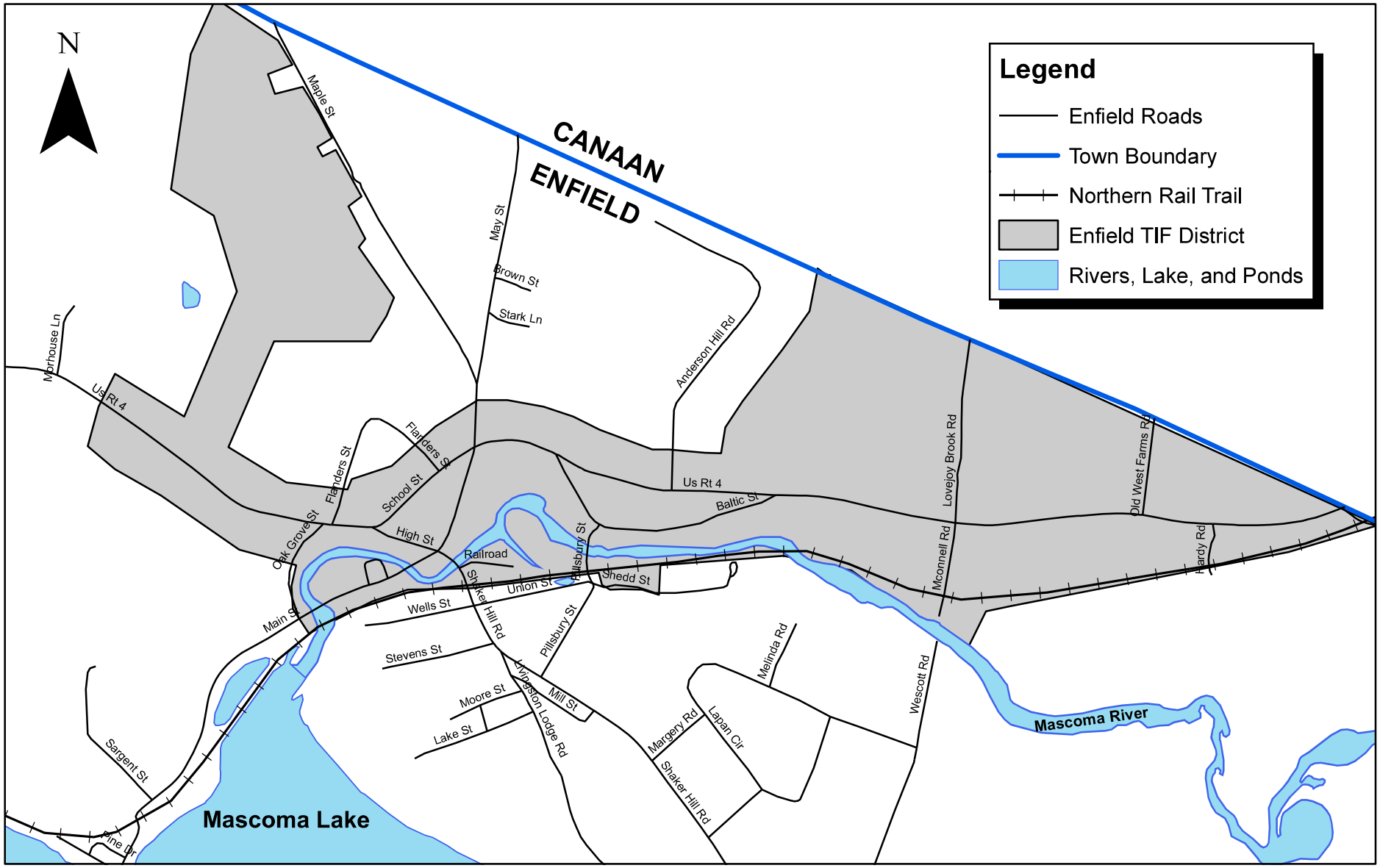
U V L S R P C

MAP CREATED BY THE UPPER VALLEY LAKE SUNAPEE REGIONAL PLANNING COMMISSION, REVISED JANUARY 2007.

Sources:
Road layer developed by the New Hampshire Department of Transportation. Other base Map features, including water layers, were derived from USGS 1:24,000 scale digital line graphs, distributed by the University of New Hampshire Complex Systems Research Center.

Note:
The Town of Canaan does not currently have a zoning ordinance in place. However, the town has written its first zoning ordinance, and released it for public review in late 2006. The zoning ordinance will be voted upon at the Canaan Town Meeting in Spring 2007. The City of Lebanon Zoning Ordinance was last revised in May, 2003. The Town of Enfield Zoning Ordinance was last revised in March, 2006.

ENFIELD TIF DISTRICT- U.S. ROUTE 4 CORRIDOR MANAGEMENT STUDY

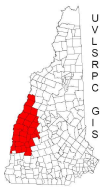


Scale 1:15,000

U V L S R P C

MAP CREATED BY THE UPPER VALLEY LAKE SUNAPEE REGIONAL PLANNING COMMISSION, JANUARY 2007.

Sources:
Road and rail layers developed by the New Hampshire Department of Transportation. Other base Map features, including water layers, were derived from USGS 1:24,000 scale digital line graphs, distributed by the University of New Hampshire Complex Systems Research Center. TIF District boundaries developed from the official records of the Town of Enfield.



APPENDIX B- PUBLIC MEETING SUMMARIES

Route 4 Corridor Management Study- Public Meeting Summary

Meeting Locations:
Canaan Selectboard, October 25, 2005
Enfield Planning Board, October 26, 2005
Lebanon Open House, November 29, 2005

TRAFFIC CONCERNS

Left Turns

Traffic back-ups are occurring at various locations due to left turning vehicles waiting to cross traffic.

- Goose Pond Rd (also difficult to exit onto Route 4)
- Switch Rd
- Roberts Rd
- Blackwater Rd
- Turning lane is needed in the vicinity of Barker Steel

Vehicles often pass on the right when waiting behind left turning vehicles. This occurs frequently at Brookside Plaza where entering and exiting is confusing.

Sight Distances

Natural and/or physical obstructions make entering the traffic stream difficult due to poor sight distances. The following locations were identified as problematic:

- Anderson Hill Rd, left onto Route 4
- Route 4A, left onto Route 4
- Main Street and Route 4
- Route 4 in the vicinity of Shaker Valley Auto

Intersections

Several intersections were identified as problematic including:

- Route 4/Route 4A, Congestion
- Main St/Route 4, Congestion
- High St/Route 4, Congestion (may be related to bridge detour)
- Enfield Village School/Route 4 (traffic officer needed during peak periods)
- Trucks turning from Route 118 onto Route 4 west are a safety issue
- On occasion, traffic backs up on the I-89 Exit 17 southbound exit ramp during the afternoon peak period

Traffic Generators

The following were identified as significant traffic generators affecting the Route 4 Corridor:

- Dartmouth College and Dartmouth Hitchcock Medical Center
- Enfield Village School (vehicles back-up to Petromart)
- Motorcycle weekend pass-through traffic
- Canaan Speedway

- Hammond Recycling (Town of Orange)
- Mascoma Valley Regional High School
- Recreation traffic to/from White Mountains
- Traffic to and from Plymouth, NH
- East/West Lumber traffic to and from the Baker River Valley
- Canaan ATV Park
- Cardigan Mountain State Park

Other Traffic Concerns

- Large trucks and their J-brakes cause excessive noise
- Lighting at Switch and Roberts Rd. intersections may need enhancement
- Traveling westbound and making right turns onto Riverside Drive is problematic
- There is a new access road near Bearly Used Bookstore. What's this road for?
- Steep climb uphill along Route 4 between Enfield and Brookside Plaza
- Shaker Hill and Jones Hill Roads are often used as a bypass to Canaan
- Need alternate routes of travel (e.g. connect Route 10 to Route 4)
- Need better traffic circulation near Post Office in Enfield to avoid using Route 4
- To what extent do commuters use Ruddsboro Road for a short cut? Does this adversely affect residents?
- Riverdale Drive is used as a shortcut to reach Route 120
- Sunset Rock Road is used as a shortcut around the Route 4/4A intersection to Hanover
- Route 4A is an important historic and cultural resource in the Town of Enfield

ACCESS MANAGEMENT CONCERNS

Brookside Plaza, Enfield and the Canaan Expressmart were identified as emerging access management problems. Brookside Plaza was found to have confusing entrance/exit and a short-throated entrance. The Canaan Expressmart also has confusing entrance, and has parking that is not well defined.

Several ways to mitigate access management problems were discussed including amending Master Plans, driveways access regulations and Site Plan Review regulations. Also, the Route 4 Corridor Study should provide a framework for state access permitting along Route 4.

The Enfield TIF District was identified as an area to employ access management techniques including frontage roads. The Brookside Plaza vicinity was also identified as being a potential location for a frontage road.

LAND USE CONCERNS

There are many limitations to development within the corridor, including:

- Natural limitations (soils and slope)

- Location of existing development

Existing Development

- Concerns about how development impacts neighboring communities

Future Development

- Route 4 from High Street to Lebanon has development potential despite natural constraints
- Development potential exists near the Listen Center
- Proposed Dunkin Donuts in Enfield will cause left turn for eastbound traffic entering during morning commute (will act as conflict point)
- It is believed that the current electrical capacity is not sufficient for power-intensive industry beyond Barker Steel eastbound on Route 4
- Land adjacent to Shaker Valley Auto site being considered for grocery store development
- Potential housing development on Roberts Rd (16 units)
- Possible grocery store on Route 118
- Housing development planned for on Switch Rd (18 units)
- Housing development planned for Goose Pond Rd (38 units)
- Industrial growth potential at Route 4/Potato Road
- The Mascoma Valley Regional High School may relocate across from Enfield Village Pizza
- There is new commercial and residential development planned at Route 4/Depot St in Canaan
- Community Center development planned at “Cozy Corner”
- Ongoing village redesign efforts in Enfield and Canaan
- Enfield TIF District development should be consistent with the village character (e.g., sidewalks, frontage roads, curbing, parking behind buildings, mixed-use, small shops and transit use including bus stop and shelter)
- Enfield or Canaan becoming an employment center could compound traffic congestion due to direction of commuters
- Developers should pay their fair share of necessitated infrastructure improvements
- Additional development is expected in the George Hill Road area
- The Lebanon drinking water protection area is a significant development constraint
- There is a proposed housing development west of Route 4 in Lebanon

ALTERNATIVE TRANSPORTATION CONCERNS

The need for infrastructure such as sidewalks, park-and-rides, and crosswalks to support alternative transportation modes was noted. Other incentives to encourage transit use would also be helpful, including the construction of sidewalks in key areas along Route 4.

- Crosswalks and sidewalks are needed to make connections between schools and general stores as a priority (Mascoma Valley Regional High School to general store mentioned)
- Need sidewalks from Canaan's School Street to Canaan Village
- Need sidewalks from Main Street to Brookside Plaza
- Need sidewalks from Cambridgeville to Prospect Pines
- Need more frequent transit service, not just for commuting (e.g. to Route 12A)
- The Methodist Church parking lot in Canaan is currently being used as informal park-and-ride lot
- Need park-and-ride at I-89 Exit 17
- Commuter parking at Hews Park (town-owned) interferes with recreational parking
- Make sure future development encourages alternative modes of travel
- Transit use is critical to the long-term management of the corridor
- The Northern Rail Trail is an important resource
- Footbridge across the Mascoma at McConnell Road would improve access to the rail trail. Currently only two legal access points to the trail exist in Enfield (McConnell and Hardy Roads)

OTHER CONCERNS

- A high speed rail feasibility study should be conducted for the Route 4 Corridor
- There are scenic views from Route 4 near Great View and west of the general store in Lebanon
- Surface water runoff is heavy in the area west of Route 4/4A due to ledge, this also causes mudslides
- The Moose Mountain area to the north of Route 4 is a significant natural resource

APPENDIX C- BUSINESS OWNER SURVEY RESULTS

Total Surveys Mailed = 68
Number of Completed Returns = 25
Total Response Rate = 37

U.S. Route 4 Corridor Management Study – Lebanon, Enfield, Canaan Survey of Business Owners

Your participation in this survey is strictly voluntary. **Individual survey responses will remain confidential.**

1. In which community is your business located?
   0 a. Lebanon 19 b. Enfield 7 c. Canaan

2. What type of business do you have?

   5 a. Services
   7 b. Professional
   1 c. Manufacturing
   2 d. Wholesale
   9 e. Retail Sales
   3 f. Lodging/restaurant
   4 g. Other

   - Complete family hair care and tanning salon
   - Apartment building
   - Apartment house
   - Warehouse/multi tenant

3. How many employees report to work at the business site on U.S. Route 4?
   12 1-5 10 6-10 1 11-20 1 >20 1 No Response

4. Access points along highway and road corridors are important for the public's transportation needs; however, excessive or poorly planned access can have a major impact upon safety and roadway capacity. In our study we will be looking at "access management" strategies to address this.

   a. How many driveway entrances/exits does your business have?
   9 1 Entrance
   12 2 Entrances
   3 3 Entrances
   1 4 Entrances

   b. How many of the driveways access U.S. Route 4?
   2 0 Driveway
   10 1 Driveways
   10 2 Driveways

2 3 Driveways
1 4 Driveways

5. Do you have any plans for business changes *at your current location on U.S. Route 4* in the next ten years? 13 Yes 11 No 1 No Response

If *yes*, which of the following do you expect to change? And by how much? (Specify on the blank lines.)

A. Employees	Increase	Decrease	No change	No Response
	11	0	13	1

Changes anticipated:
No significant changes mentioned, only a slight increase in employees for a few businesses.

B. Production	Increase	Decrease	No change	No Response
	9	0	15	1

Changes anticipated:
One new access to a business and one business will be offering new products and services.

C. Floor space	Increase	Decrease	No change	No Response
	8	0	16	1

Changes anticipated:
One addition, one building and one expansion up to 30,000 sq ft

D. Shipping rate	Increase	Decrease	No change	No Response
	3	0	21	1

Changes anticipated:
No significant changes.

E. Utility demand	Increase	Decrease	No change	No Response
	8	0	16	1

Changes anticipated:
No significant changes.

6. Is your business served by municipal water? If not, does this affect your business activity or expansion plans?
_15_ Yes _9_ No _1_ No Response

Explain:
One response that it will affect their plans.

7. Is your business served by municipal sewer? If not, does this affect your business activity or expansion plans?
_11_ Yes _13_ No _1_ No Response

Explain:
One response that it does affect their plans for expansion and one that sewer should be covered further.

8. How do you feel about the following conditions on U.S. Route 4 today?
(1 = no problem and 5 = serious problem)

Current Conditions on US Route 4	1	2	3	4	5	No Opin	No Resp	Comments
a. Passenger vehicle traffic congestion	6	4	7	5	2	0	1	Congestion is too high at AM and PM hours and Enfield Village School traffic adds to this.
b. Traffic speed	8	4	8	1	2	1	1	Concerns that trucks are speeding, conflicting views that it is too slow vs. too high and that speed limits are generally ignored.
c. Traffic safety	7	6	4	6	0	1	1	Traffic safety has been improved by new intersection of Route 118 & Route 4, but there are also complaints of speeding, egresses are too short and there is much needed safety near schools.
d. Truck traffic	6	7	4	5	1	1	1	General concerns with noise pollution and speeding.
e. Traffic noise & exhaust	7	6	5	3	2	1	1	Noise pollution from trucks and motorcycles as well as engine brakes in town from trucks and to prohibit parking along sides of Route 4 for large trucks.
f. Traffic turning & entering from businesses or driveways	6	6	1	9	1	0	2	Visibility is lacking, speeding, rush hour and the school entrance are problems.
g. Intersections – delays and safety	7	2	5	5	4	0	2	Morning and afternoon delays particularly by Mascoma and Enfield schools as well as the Route 4/4A intersection. Enfield/Main St and Route 4 could use traffic lights during segments of day.
h. Transit service	11	4	1	2	0	5	2	Transit service is well received, but all suggestions are to expand service with more frequent stops and more shuttles especially for senior citizens that do not have cars.
i. Pedestrian and bicycle facilities	2	4	4	6	6	2	1	Need sidewalks, bicycle lanes and improvements to Northern Trail - better lighting or paving.
j. Quality of life along Route 4 (scenic beauty, community feel, etc.)	6	4	7	5	1	1	1	Same problems areas, clean up area near Mascoma HS and keep old buildings in good condition.
k. Strip development (sprawl)	9	7	2	2	2	2	1	
l. Other Concerns: More sidewalks and wider roads are needed. Controlling new housing to blend style of current historic older buildings while adding growth is important. Transit from Enfield to Canaan would be helpful for local population.								

9. Do you feel any of the following changes are needed on U.S. Route 4?

	Yes	No	No Resp	What type and Location(s)
a. Intersection improvements (e.g. signalization)	16	7	2	Concerns for Mascoma Valley Regional High School as well as Downtown Canaan. Traffic lights were suggested for both areas and an officer at the high school. Main Street and Maple Street were also mentioned, but no specific suggestion of changes.
b. Improvements to highway shoulders	15	8	2	Wider roads needed, Dry Bridge Hill, lake area needs sidewalks for pedestrians, shoulders for walkers and bikers, divert walking/bike traffic to Northern Trail many areas were there is none or not a large enough break down lane, turning lanes near schools
c. Limiting the number and width of driveways to lessen traffic turning conflicts and improve safety (access management)	5	17	3	Concerns that visibility is the bigger issue and that curbing is needed for entryways
d. Additional left turn lanes	17	4	4	Needed at Enfield House of Pizza, schools and cross roads with more usage.
e. Additional truck passing lanes	8	13	4	Would be helpful on hills that cause the trucks to slow.
f. Transit enhancements (e.g. More scheduled runs, additional Park and Ride lots, etc.)	15	6	4	More scheduled runs would help with congestion.
g. More sidewalks	21	2	2	Sidewalks where Northern Trail is not accessible, along Route 4 and in central business areas or villages. If the Northern Trail was paved, might help increase safety.
h. Crosswalks and other pedestrian amenities	18	5	2	Needed in central business areas or villages, near schools, large intersections and in areas of poor visibility.
i. More appropriate speed limits and/or enforcement	8	13	4	Lack of slow vehicle lanes causes speeding and illegal passing. Needs to be enforced. Speed limits are considered acceptable, but improved highway shoulders, increased police presence or speed indicator would help.
j. Bicycle lanes/paths	15	7	3	Route 4 needs bike and pedestrian friendly lanes or sidewalks.

k. Changes in zoning	6	11	8	Control strip development,

l. Other suggestions?

- "3rd lane necessary in near future. A through E busy area from Canaan town line to past elementary school should have 3rd lane"
- "Enfield area - #1 pedestrian walks, #2 bicycle lane, #3 crosswalks access to lake, #4 town water – from Lebanon town line to #5 town sewer Enfield Center"
- "I would like to have the growth of Route 4 provide the services Enfield residents and businesses need. Functionally, I would like to have traffic controls developed without the use of traffic lights. Enfield elementary school creates a bad traffic situation during peak hours. Relocation of their primary access would resolve many of the peak hour concerns."

10. Do you feel that there should be an increase, decrease or no change to the following along U.S. Route 4?

	Increase	Decrease	No change	No Resp.
A. Open Space Protection	8	1	12	4

Explain:
Already commercial, focus elsewhere as Route 4 is perfect for commercial development.

	Increase	Decrease	No change	No Resp.
B. Commercial Development	18	1	3	3

Explain:
Controlled.

	Increase	Decrease	No change	No Resp.
C. Residential Development	7	6	7	5

Explain:
Controlled and limited would be better to keep commercial on Route 4 and have residential along Route 4, but on secondary side roads.

	Increase	Decrease	No change	No Resp.
D. Concentrated Development (as opposed to strip development)	10	6	5	4

Explain:
Be careful to keep existing businesses in business and not ruin the culture of the small town.

E. Business support services	Increase	Decrease	No change	No Resp.
	12	0	2	11

Explain:
Sewer and water, grocery, medical facilities, restaurants, increased advance transit services, better lighting

F. Highway Capacity	Increase	Decrease	No change	No Resp.
	15	0	3	7

Explain:
Additional and wider lanes, paved shoulders, slow down traffic speed and increase enforcement for safety.

APPENDIX D- LANDOWNER SURVEY RESULTS

Total Surveys Mailed = 50
Number of Completed Returns = 14
Total Response Rate = 28%

U.S. Route 4 Corridor Management Study – Lebanon, Enfield, Canaan Survey of Landowners

Your participation in this survey is strictly voluntary. **Individual survey responses will remain confidential.**

Please feel free to enclose any additional comments regarding U.S. Route 4 and your development plans, or any other aspect of U.S. Route 4 that you feel deserves attention. *Thank you very much for your time!*

6. In which community is your undeveloped land located?
   - 4 A. Lebanon
   - 7 B. Enfield
   - 7 C. Canaan
   - 1 No Response

7. Do you have any plans to develop your land in the next ten years?

   5 Yes 8 No 1 No Response

8. Is your land served by municipal water? If not, does this affect your development plans?

   3 Yes 8 No 2 No Response

9. Is your land served by municipal sewer? If not, does this affect your development plans?

   2 Yes 10 No 2 No Response

10. How do you feel about the following current conditions on U.S. Route 4 today? Please comment on whether or not any of these conditions have any bearing on your development plans. **(1 = no problem and 5 = serious problem)**

Current Conditions on US Route 4	1	2	3	4	5	No Opin	No Resp
a. Passenger vehicle traffic congestion	3	2	2	2	3	1	1
b. Truck traffic	3	2	3	2	2	1	1
c. Traffic safety	3	3	3	1	2	1	1
d. Pedestrian and Bicycle facilities	4	2	4	2	0	1	1
e. Traffic turning & entering from businesses or driveways	5	0	1	3	3	1	1
f. Strip development (sprawl)	1	4	5	0	2	1	1
g. Quality of life along Route 4 (scenic beauty, community feel, etc.)	2	1	3	1	5	1	1
h. Traffic speed	2	1	4	1	2	2	2
i. Traffic noise & exhaust	3	4	2	0	2	0	3
j. Transit service	4	4	2	1	2	0	1
k. Intersections - delays and safety	4	3	2	1	3	0	1

l. Other Suggestions

Concerned that with the amount of traffic we should seek alternate routes possibly through Hanover to help with commuters heading to that area.

Reevaluate traffic flow surrounding businesses.

Currently there is no consideration for environmental quality.